ELECTRICAL REVIEW

ILLUSTRATED.

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WHAT THE GOVERNMENT SHOULD DO FOR ELECTRICITY.

LIST OF THE APPROPRIATIONS ASKED FOR OF INTEREST TO ELECTRICAL WORKERS.

Among the appropriations which Congress will be asked to make are the following items relating to electrical matters:

For completing the electric lighting plant for the Statue of Liberty in New York harbor, $5,250. The original estimate of $26,000 made by the Light House Board for this work was reduced to $19,500, and the additional sum is needed to finish the work.

The keepers of the electric buoy station on the New Jersey shore of New York harbor, have politely hinted that the weather is getting rather too cold for comfortable living in tents, and $3,500 is asked for to build a dwelling house with.

The Watervliet arsenal, at Troy, wants $22,000 for an incandescent electric lighting system, and $5,000 for one 150 horse-power engine for driving dynamos. The Commandant says illumination by gas has proved a source of much trouble, and electric light is much better adapted to the needs of the arsenal.

For a telephone system at the West Point Military Academy $2,000 is wanted.

In the estimates for the Soldiers' Home at Milwaukee, an item of $41,156 includes provision for electric lights.

The Signal Office states that since electric lights have been used for public buildings, the display of cautionary signals by means of ordinary oil lanterns is rendered ineffective on account of the greater brilliancy of electric lights, and, to remedy this difficulty, requests an appropriation of $1,000 for electric cautionary signal lights at Boston, New York, Chicago and other important cities. One hundred and twenty thousand dollars is the amount needed to pay the telegraph companies for transmitting weather reports.

In addition to the items for lighting in naval establishments, heretofore published in the REVIEW, are the following:

For an electric lighting plant in the Navy Yard at Boston	$15,000
For increasing electric lighting plant in the Navy Yard at Brooklyn	24,000
For increasing electric lighting plant in the Navy Yard at Norfolk	15,000
For completing electric lighting plant in the Navy Yard at Mare Island	30,000

For lighting the streets of Washington and Georgetown, $45,000 is needed. The White House and grounds are lighted by seven arc lamps, 365 nights, for which the local company demands 70c. per night, while the law allows the payment of only 40c. The company donates this illumination to the government this year and hopes to get a fair price next year.

In the Treasury estimates there is an item of $718,420.34 for fuel, lights and water for all the public buildings under that department, and an item of $16,000 for contingent expenses, which embraces something for electric fixtures.

The artillery school, at Fortress Monroe, Va., wants some galvanometers and other measuring instruments and supplies to the amount of $1,538.

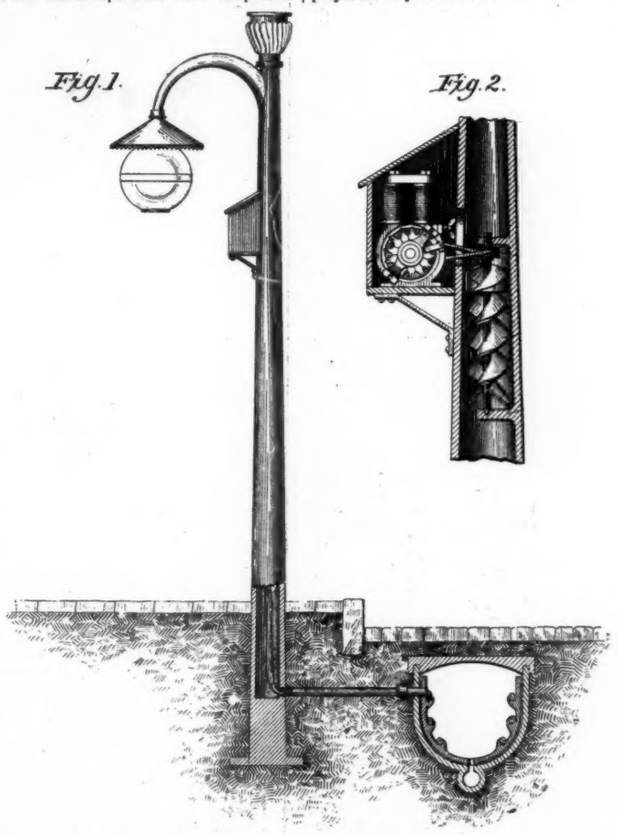
The Light House Board has outgrown its quarters in the Treasury building, and has requested the appropriation of $210,000 for a new building in Washington to provide accommodations for an extensive laboratory.

The Commissioner of Public Buildings recommends the removal of all pole lines in the departmental telegraph system, and submits the following estimate of the cost of substituting underground lines:

110,000 feet of conductor at 4½ cts. per foot	$4,950
Supervising expert joiners, electricians, etc., for laying conductors, at ½ cent per foot	550
Ditching, boxing, etc., 10,500 feet, at 22 cents per foot	2,320
Contingencies	680
	$8,500

The superintendent of the Naval Observatory, in explanation of a request for $5,000 for extension and maintenance of the telegraphic time service, says the service has proved very valuable to the public generally and should be encouraged and established on a firm and independent basis. At present signals to the several time-balls are transmitted by the Western Union Telegraph Company without cost, and several of the time-balls are hoisted and cared for by private individuals without compensation. The time signal business is one of the things in which the interests of different classes of citizens need harmonizing. Several of the leading observatories in the country obtain some aid in carrying on their scientific and educational work, from money paid by railroads and other establishments for time signals, and they are averse to having this business destroyed by the Government.

The Commissioner of Patents recommends an increase of salaries of the assistant commissioner from $3,000 to $3,600; examiner of interferences, from $2,500 to $2,800; 30 principal examiners, from $2,400 to $2,800; and says, "it is impossible for the Government to command and retain men who possess the requisite ability to discharge the duties exacted of officers occupying these several positions unless the salary be made commensurate therewith. In view of the arts which have been discovered from time to time, the diligence with which they are developed by the most eminent scientists in the world, and also in view of the growth and expansion in all the fields of research and knowledge, a higher order of talent and ability is essential for the proper examination of applications for patents than when the salary was established in 1848. Unless Congress shall recognize this fact, and make provision accordingly, this office will continue to be used as a place of instruction for young and capable men, who, so soon as equipped and trained as to make their services of value to the Government, resign their positions to accept more lucrative employment in private life."



METHOD OF VENTILATING SUBWAYS.

Appropriations recommended for telegraph operators:

U. S. Senate	$1,200
House Representatives	900
Treasury Department	1,200
Navy Department	1,200
Post Office Department	1,600
Department Justice	1,200
Public Printing Office	$4 per day
Navy Yard, Washington	900
" " League Island	1,000
Signal Office:	
2 operators at	1,200
2 " "	1,000
3 " "	900

An Electro-Technical Exhibition.

At a meeting of merchants, engineers, financiers and scientists, held at Frankfort, a committee was appointed to make arrangements for an international electro-technical exhibition, to be held from June to October next year. Dr. Siemens, Mr. Edison and Sir William Thomson were nominated honorary members of the committee.

Tintypes by Electricity.

The latest electro-mechanical contrivance, and one that has not yet been made public, is a machine made in Boston, working by electricity, for taking tintypes. It is made in the style of the "slot" machines, now so common. A person stands on a platform, drops a dime into a slot and the machine prints and carries the tin negative to the various baths necessary for developing, and in a few minutes hands the completed tintype to the patient waiter. The only obstacle to success thus far is the question of light on dark days, and experiments are now being made for the purpose of using the electric light, if feasible.

How to Ventilate Subways.

A method of ventilating electrical subways is illustrated in the REVIEW this week. This is the invention of Isaac La Rue Johnson, of Washington, D. C., and is specially designed for ventilating the conduits now being put down for carrying electric wires. The tubular form of the lamp-post is made use of as an exhaust pipe and as a conduit for conveying a current of electricity from the main conduit or subway to a motor for driving a suitable exhaust fan; and it further consists in so constructing and adjusting the exhaust fan as to prevent a downdraft through the lamp-mast, thus preventing the admission of the external air through said mast, which thereby prevents the discharge of the foul or damp air from the conduit, preventing explosions which occur when atmospheric air mingles with illuminating and other gases.

Fig. 1 is an elevation, partly in section, showing a conduit and the means of connecting the conduit and the lamp-mast, a motor case on said mast, and the conductors leading from the cable in the conduit to the interior of the mast and thence to the motor, and a hood or cowl is placed at the top of the mast. Fig. 2 is a sectional elevation, showing the exhaust fan and its motor.

The operation of the mechanism is readily understood. A suitable number of masts may be employed on a line of subway. The conduit may be of any desired form. The pipe which connects the mast and conduit by suitable air and water tight joints, conveys the current (through suitable conductors), both for power and light from the conductor to the lamp and motor. The case containing the motor is provided with a door or opening through which the motors may be started or stopped and through which they may be reached for repairs. The fan, having any number of spirals and of any desired pitch, is actuated by the motor through the belt and pulley connections, as shown and this exhausts the air or gases in the mast and its continued operation removes all that may gather in the subway and its connections.

The Eleventh Census.

A letter dated Washington, D. C., December 7th, 1889, has been written from the Department of the Interior, Census Office, signed by Mr. Robt. P. Porter, superintendent of census.

In this letter all persons interested in the electrical industry are informed that under the authority conferred by act of Congress, Allen R. Foote, of Cincinnati, O., has been appointed as special agent of the census, to have charge of the collection of statistics of the electrical industry.

Mr. Porter earnestly requests that Mr. Foote may secure the hearty co-operation of the electrical fraternity in making this report a complete and accurate one.

INSULATION IN MARINE WORK.

INTERESTING HISTORY OF THE INSULATION AND ARRANGEMENT OF ELECTRIC CONDUCTORS ON BOARD GOVERNMENT SHIPS—THE VARIOUS WIRE AND ELECTRIC LIGHT SYSTEMS USED—WHAT IS EXPECTED IN FUTURE.

TO THE EDITOR OF ELECTRICAL REVIEW:

The following notes relating to the development of the insulation of electric conductors for naval use have been prepared from the files in the office of the Naval Inspector of Electric Lighting:

The secret of all success in electric lighting, and especially aboard ship, is a good, durable and well-protected insulation. This is the initial and absolute essential; other points are largely matters of detail. In the early days this fact, if recognized, was not fairly considered. To-day, and thanks in a large measure to the office of the Naval Inspector of Electric Lighting, established in 1887, not only the installations in the cruisers now building, but from competition amongst manufacturers, drawing their inspiration from the requirements of that office, commercial plants as well, give evidence of increased excellence in this regard.

It does not seem to be difficult to manufacture an insulation that will answer all requirements when new. The great trouble has been to obtain durability when subject to the varying conditions of heat and cold, dryness and moisture, and the rough treatment incidental to use aboard ship. Vast quantities of materials have been brought into requisition, such as resins, which are usually too brittle, or when mixed with tar too easily softened by heat, allowing the conductor to sink through; asphaltum and bituminous compounds, which have been favorably mentioned; tar and pitch, not regarded as trustworthy when used with rubber or gutta-percha, the latter suffering injury from the action of the solvent oils; paraffin, which shrinks on cooling, and tapes soaked in the latter, which are rotted by the free acid; asbestos, which resists heat and the action of acids, but absorbs moisture; ozokerite, a crude native paraffin, originally like petroleum, but from which the more volative components have escaped, found in Galicia, lately in Utah, applied in various ways to rubber, supposed to shorten the life of the latter; cotton, silk, flax and jute, with or without shellac or paraffin, which do not withstand changes of temperature or moisture; gutta percha, better than most of the above, but must be kept under water or at a uniform temperature, hence, unsuited to ship's use; and lastly, india rubber, well-nigh universally recognized as the most desirable material, but on account of its comparatively high cost not used to a considerable extent in its pure state, but more or less adulterated with many of the above-mentioned substances. In this brief list no mention has been made of the numerous patented compounds, which possess greater or less excellence according to the cost and care of their manufacture and the use for which they are designed, but it is safe to say that not one of them equals in insulating properties and durability, under the changing conditions, pure india rubber, but in the struggle to obtain a cheaper commercial article approximates to it in excellence more or less in the ratio of its cost.

The qualities recommending pure rubber are its high insulation, its durability, flexibility, elasticity, its power of withstanding changes of temperature and moisture, and its immunity from the harmful action of most acids. There are, of course, cases in which it is not necessary to use pure rubber for the whole thickness of the insulation. For large conductors, such as are used for electric lighting, it is sufficient to have a layer of pure rubber to begin with, and vulcanized rubber compounds and tapes outside. In all cases it is necessary to prevent access to the copper of the sulphur of vulcanization, as the former would be thereby soon attacked and corroded. Likewise the pure rubber must be protected from any possible heating of the conductor when accidentally traversed by strong currents. These objects are attained in the best wire of to-day, as follows: The copper strands are covered with a heavy, smooth and a uniform coat of tin. The latter metal resists most of the chemical actions that would injure the copper. The conductor, of a single or several twisted strands, is then wrapped with a thoroughly dried cotton parceling, or is braided with cotton, and is soaked in a pure rubber solution. After that comes a ribbon or sheet of pure rubber, technically called brown rubber; then a layer of rubber containing no sulphur, usually mixed with zinc oxide, and called the white rubber or separator; then a layer of vulcanized rubber, called black rubber, or a layer of Okonite, and lastly a cotton parceling, or preferably a braiding, soaked in ozokerite or some insulating compound. A disadvantage of having cotton next the wire is that it collects moisture. This may be prevented by having it thoroughly dry when put on and applying the pure rubber at once in a dry atmosphere. An incidental advantage is that it keeps the surface of the wire clean and bright. The real reason for its use, however, is that it keeps the pure rubber from softening when the conductor is overheated. Para rubber is the best and purest form in use and is stipulated in the latest navy contracts. The outer layer is vulcanized to render it more durable, and the white rubber separator prevents the sulphur from penetrating. A lead covering is now generally used in ship lighting. It must be pure and soft to stand bending, and thick enough to resist abrasion. Its object is to prevent access of salt water to the conductor, and to permit the whole system to be made water tight. An incidental advantage is that it prevents to a great extent the drying and cracking of the insulation. Tin is sometimes alloyed with the lead in underground conductors, and is said to render it less liable to oxidation and pitting. A covering of jute gives it additional protection.

It is not to be supposed that such insulation as this was manufactured a few years back. It will be interesting to follow its development as shown in plants so far installed in ships of the navy. The "Trenton" was the first man-of-war lighted by electricity, and was installed by the Edison Company in the summer of 1883. The specifications required that the conductors should be of the most improved pattern used by the Edison Company for isolated lighting. The present inspector of electric lighting supervised the installation in a general way and served as executive officer of the ship during the ensuing cruise. The company, however, was primarily responsible for the material, having ample latitude under the contract. It is safe to say that they supplied the best insulation at that time to be had in this country, though fears were entertained of its ultimate adaptability to the requirements of shipboard. The conducting mains were of a single strand of copper in two sizes, Nos. 12 and 14 B. W. G. The larger wire was covered with three braidings of cotton, the inner one soaked in bituminous compound and the outer one painted. The smaller wire was wrapped with cotton thread, soaked in a compound, then braided with cotton and painted. Neither of these insulations proved efficient. The first answered fairly well, but principally owing to the protection afforded by well-painted wooden moldings enclosing the wire. The second frequently gave out, softening and allowing salt water to reach the wire. The branch wires for single lamps were of two sorts, both No. 18 B. W. G., one tinned and rubber coated, the other similar to the No. 14 above. The rubber was of poor quality, broke off and did not stand heat. The coating of tin, however, prevented the access of salt water and consequent corrosion. On that account it was recommended in the future to tin thoroughly all wires for ship lighting. The other branch wire proved worthless and had to be replaced during the cruise. The vicious effects of salt water seemed so apparent that a lead covering for all wires was recommended. Thus it is seen that this plant, while in the main successful, afforded valuable lessons for future guidance.

It will be proper here, in point of time, to mention two installations, both by the Edison Company, which, while intended to be the best, were not directed by the Bureau of Navigation, and were not on the lines of the experience gained in the "Trenton." The first was the "Dolphin," in the summer of 1884. The building contract required her to be lighted by electricity, and the contractor was at liberty to select any system. The conductors employed were of copper, tinned, insulated with rubber tape. In the smallest size a painted cotton covering took the place of the rubber tape. Moldings were not generally used, but in some cases a light batten was employed for appearance or for protection from salt water. This type of protection has proved fairly satisfactory. In some cases water has reached the wire with the usual corrosive effect, though the faults were stated to be due to improper leads and carelessness in wiring rather than to the character of the insulation. It was recommended to paint the parceling.

The other installations referred to was that of the "New Hampshire," in the autumn of the same year. Her mains were of No. 16 double conductor wire. Each strand was first parceled with cotton and served with thread, and the whole soaked in melted paraffin. The two were then wrapped together with rubber tape and thread and again paraffined. The idea of this poor insulation of the mains from each other was that in case of a fault or short circuit, before the current could do much damage, the insulation would be heated and perforated, the conductors would come together, act as a fuse, and the circuit would be broken. This system was not successful in practice. Safer and more economical means can be devised to accomplish the same end. For the branch leads, two sizes of wire, Nos. 17 and 18 B. W. G., both tinned, were employed. The former was rubber, insulated and parceled with tape, and proved the most satisfactory of the installation. The other was insulated with gutta percha, which, as has been seen, does not stand change of temperature, is brittle when cold, cracking and breaking, and soft when hot, allowing the wire to sink through. No moldings were used; salt-water penetrated the insulation and corroded the wire. The double conductor mains were shortly replaced by torpedo wire. In the spring of 1888 the ship was entirely re-wired with Okonite wire laid in wooden moldings. It is reported to give satisfaction.

In the summer of 1884 specifications were got out for the "Atlanta," "Boston" and "Omaha." They were identical in requiring the conductors to be of copper wire, tinned, insulated and laid in pure lead tubing. The "Omaha," installed by the Consolidated (Sawyer-Man) Company, was the first completed, in the spring of 1885. The two sizes of conductors were used, Nos. 6 and 16 B. W. G., consisting of a single strand of copper, tinned, insulated with two layers of cotton braiding soaked in paraffin and lead-covered. They were secured by iron staples and were generally without the protection of molding. The first reports on this wire were favorable. In the latter part of 1887 leaks were first noticed, the lead having been found cracked and the wire corroded. In the beginning of 1888 the ship was recommissioned for another cruise and large quantities of new material sent out to replace the old. The new wire was rubber insulated, lead

NEW MAGNETO TESTING SET.

covered, and similar to the best samples of the time, to be described later. In regard to the old wire then in the ship, that on the spar-deck and engine-room circuits was described by the officer in charge of the plant as completely useless. The lead covering had been cut through by the staples, the cotton insulation rotted by salt water, and the wire grounded. It was considered that a lead covering, on account of the facility it afforded for grounds, was not desirable except with perfect insulation, and iron staples, it was thought, should never be used. In the latter installations the practice has been to use a flat fibre staple to secure the lead-covered wire in the moldings. The material is tough and elastic and is not affected by salt water. Specially devised instruments are employed to puncture holes for them in the wood and to set them home; they do not stand driving with a hammer. The driving tool should be constructed in such manner as to prevent setting home too hard and thereby cutting the lead.

Next we come to the "Atlanta," installed by the United States Company (Weston system) and finished in the autumn of 1886. Two sizes of wire were used, Nos. 10 and 18 A. W. G., each a single strand tinned, wrapped with thread, covered with a preparation of rubber, a paraffined braiding, and a lead coating. This wire answered for a while. The first report of broken lead, entrance of salt water and corrosion was in the second quarter of 1888. The trouble occurred in the after orlop, though other portions must have been more exposed. It is an instance of how salt water finds its way everywhere. Portions of this wire subjected to continuous heat over the wire gave evidence of a thorough baking and disintegration of the insulating materials. The process of vulcanization is apt to go on under these circumstances till all the rubber is a solid mass. The separator and pure rubber must be depended on to stop the injurious action. In 1887 samples of Okonite wire, with and without lead cover, were received for trial. These samples were of the same size as the original conductors, had a layer of Okonite next the tinned wire, and a braiding soaked in an insulating compound.

The "Boston" was installed by the Brush Company, and finished in the spring of 1887. The wire supplied was like the "Atlanta's" in every respect. In the third quarter of 1887 it was reported that salt water got to the wires where passing through the steel decks. Bad insulation was assigned as the cause. During the installation of these two ships they were inspected from time to time by the present naval inspector, though the specifications and contracts were made before the establishment of his office. Their plants were certainly superior to any previously installed, and, in spite of the faults enumerated, fairly efficient.

The next wiring to be considered is that of the "Chicago," installed by the Edison Company, contracted for in December, 1886, and finished in the spring of 1888. The specifications required that the conducting wires should be tinned, covered with the best rubber insulation, and inclosed in pure lead tubing. A sample of not less than 500 feet in length should, after at least 24 hours' immersion in sea water, possess an insulation resistance of not less than 1,000 megohms per nautical mile. The conductors were of various sizes from No. 6 to No. 16, and of a single strand of copper, tinned, insulated with the white and black rubber tape, and inclosed in a lead tubing. It was found on wiring that the larger sizes were not flexible enough, and the lead cover, from insufficient thickness, sometimes broke in bending. These two faults have been remedied in later specifications, by requiring all large conductors to be stranded, and the lead cover to be at least 0.04 inch in thickness. Another advantage in stranded conductors, in addition to greater flexibility, is that all the wires are not apt to be broken together, the breakage of one or two not being fatal. But if a single conductor parts, the circuit is broken and the fault is harder to repair, if indeed it is not entirely concealed by the insulation. Lighting companies were, on account of the increased cost, loath at first to make this change, but the advisability has now been generally recognized. The "Chicago's" plant has been in frequent operation for considerable periods, and has proven satisfactory. No opportunity has been afforded of testing the insulation in actual service at sea, but it is thought that it will fill the requirements. This was the first instance of stipulating a definite insulation resistance in the specifications. It is now a feature of all contracts.

The re-wiring of the "Trenton," likewise by the Edison Company, dates from that time. Contracted for a few months later than the "Chicago," she was finished nearly a year earlier. The specifications were in the main similar, but there was the additional requirement that no conductor should contain a wire of greater diameter than a No. 16 B. W. G., but that the necessary area should be made up of smaller wires, in order to produce flexibility. The "Trenton," being a wooden ship, the bureau was of the opinion that with a good rubber insulation a lead tubing would not be necessary. The requirement was therefore omitted. The wire was manufactured by the India Rubber and Gutta Percha Insulating Company, of New York, the same firm that had supplied the Edison Company with wire for the "Chicago." The mains of the "Trenton" were of two sizes, using seven strands each to No. 16 and No. 18 wire respectively, or, as they are denominated technically, $\frac{7}{18}$ and $\frac{7}{16}$. The branches were a single strand, No. 16. The leads from the dynamo to the switchboard had a core of seven $\frac{7}{16}$ cables twisted together, making in all 49 strands. These conductors were all tinned, parceled with cotton soaked in a rubber solution, and insulated with layers of brown, white and black rubber successively, and lastly a parceling of rubber tape. The reports received from this ship were in the main satisfactory. Her unfortunate loss at Samoa has made it impossible to know how the insulation would have stood the further test of time.

The "Yorktown" is the last ship installed, and involves all the improvements suggested by previous experience. The contract was sublet by the builders to the Edison Company on specifications drawn by the Naval Inspector. The part relating to the character of the insulation is quoted in full.

All conductors, except fixture and portable wires, shall have:

(a) A layer of fine braided cotton.

(b) A layer of rubber containing no sulphur.

(c) A layer of vulcanized rubber or Okonite.

(d) A parceling of rubber tape.

(e) A water-proof covering of pure lead not less than $\frac{1}{16}$ of an inch thick. The insulation, exclusive of cotton and lead, shall not be less than $\frac{5}{32}$ of an inch thick. It shall, after 24 hours immersion in sea water, have a resistance of not less than 1,000 megohms per nautical mile. * * * A sample of 500 feet of the regular pattern of conductors to be forwarded to a place designated for testing.

The physical characteristics of the insulation shall not change when the conductor complete is raised to the temperature of boiling water nor upon cooling.

Insulation. — When complete, with all connections made ready for the use of each and every lamp, the insulation of the entire system of conductors, including the circuits of the dynamo, shall not be less than 1,000 ohms of resistance to every volt of electro-motive force of the dynamos. The outer coating of all conductors, all fixtures, junction-boxes, switches, receptacles for portables, and all other exterior parts of the system, shall be insulated from the ship. All junction-boxes, switches (unless otherwise designated), conductors, joints of conductors, and entrances to fixtures, shall be water-tight. The interior insulating block of junction-boxes and water-

tight switches and the bases of other switches and receptacles, also the switchboard, shall be of porcelain, slate or marble.

In making this wire the manufacturers applied first a layer of pure Para rubber over the braided cotton, which was beyond the requirements of the contract, and then the other layers as above enumerated. The conductors were accepted after a number of tests which were deemed satisfactory. It is too early yet to make predictions, but in two or three months' use there is absolutely no fault to find with the character of the insulation.

The wire supplied the "Pensacola," the "Charleston," and the "Baltimore" is similar to that of the "Yorktown." The dynamo leads are now made in a single cable of the requisite number of strands, instead of a number of seven-stranded cables laid up together, as furnished the "Trenton." On account of the difficulty of braiding over a number of loose strands, a parceling of cotton is used next the wire. This answers the requirements equally as well. An improvement has been made in the matter of the outer parceling, which in some cases worked loose in bending, by substituting for it a close braiding of cotton and soaked in ozokerite.

The flexible conductors for portable lights are of an improved form, suggested by gradual experience, and will be briefly mentioned. The double conductor form seems to be the most desirable when sufficiently flexible, as it is less likely to kink than the separately insulated and twisted strands. It was made at first with an inner stranded conductor, and the strands of the outer one disposed at intervals about it. An extra strand was put in the outer conductor to provide increased cross section and compensate for the extra resistance due to the greater length of the outer spirals. When these were tried in the "Yorktown" it was found that the outer strands, receiving no mutual support, were apt to be broken by the continual bending at the point of entering the fixture or plug. A new form, now on trial, contains two stranded conductors insulated and laid side by side, with jute fillers to give a rounded cross-section, and a double hemp braiding soaked in ozokerite laid on all over. The resulting wire is flexible, and bids fair to answer well. For use in cabins and officers' quarters, a braiding of floss silk has been employed instead of the hemp. Lately, twilled silk has been substituted, making a smoother and more durable finish. For fixtures that will not admit the regular branch leads, a small stranded conductor is used. The core consists of three No. 25 wires, tinned, insulated with white rubber, vulcanized rubber, and a fine cotton braiding soaked in ozokerite.

G. C. M.

Washington, D. C., Nov. 11, 1889.

A New Form of Magneto Testing Bell.

A new style of magneto testing bell for electric light and other circuits is now being introduced by the Viaduct Manufacturing Company, of Baltimore, Md. A novel feature of this bell is that the ringer and gongs are inside of the case. The handle, when not in use, is also placed inside, in a receptacle made for the purpose, thus leaving no parts exposed on the outside subject to accident. The binding posts are made to accommodate a wire the size of the smallest office wire, up to No. 4, B. & S. gauge. The bells are wound to full standard, ringing through 10,000 ohms, and also to extra standard, ringing through 25,000 ohms. They are put up in a handsomely polished mahogany box, with a russet strap for convenience in carrying about. Size of case, 8¾ inches long, 5½ inches wide, and 5 inches deep. (See opposite page.)

Philadelphia, Pa.—A charter was issued from the State Department to the Electric Power Company, of Philadelphia; capital, $150,000.

San Francisco, Cal.—The Singer Automatic Fire Alarm System, of San Francisco, filed articles of incorporation. The directors are E. Ransome, F. S. Chadbourne, J. W. Hastings, George A. Knight and Mark Sheldon. The capital stock is $200,000. The company proposes to equip buildings with thermostats.

Windsor Locks, Conn.—The Windsor Locks Electric Light Company is organized with C. D. Doubleday, William A. Thompson, R. W. Pope, C. H. Maclillie, of New York, and H. R. Coffin, Charles E. Chaffee, J. R. Montgency, E. B. Bailey and H. C. Douglass, of Windsor Locks, as directors. The officers elected are E. B. Bailey, president; J. R. Montgency, vice-president; H. C. Douglass, secretary; and C. H. Maclillie, treasurer.

Horizontal Boring and Drilling Machine.

The great gain which may be had by the use of machinery of special design for horizontal drilling and boring is not generally appreciated, although the product of the best horizontal boring and drilling machines is not less than three times that of the lathe or tool of the lathe style, the machine commonly used for this work. It is well within the truth to say not less than three times; usually the product is four or five times greater.

Lathes and tools of the same class, that is to say, tools which bore with a bar held between centers, while the work, fastened to a

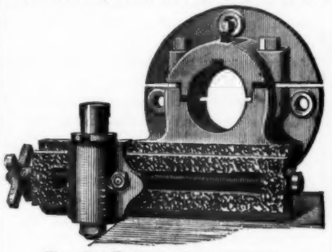


FIG. 2.—FACING ATTACHMENT.

traveling carriage, is moved along the bed, are entirely unfit for the requirements of boring and drilling straight, true holes, parallel to plane surfaces or other holes, and for facing surfaces at right angles to these holes. To begin with, they are never accurate enough to do true work; for, while a shaft can be turned perfectly straight and round in a lathe even when the centers are not in the same horizontal plane, such a condition is fatal to the truth of a bored hole which reproduces exactly the departure of the centers from the truth; and, though at first, the live spindle of the lathe is true to the dead spindle, it soon wears below the dead spindle and renders the tool unfit for boring.

Fig. 1 shows the general appearance of the tool built by the Newark Machine Tool Works, of Newark, N. J. The work is bolted to the compound carriages, which are shown directly under the boring bar, the work being set square by the top surface and the edges of the carriage, which are absolutely true with regard to the bar. The carriages can be moved either across or along the movable table, which is shown supported by the two large screws. The table can be lowered or raised from the side or at the end, as desired. With these movements of the carriages and table, using no blocking whatever, the work can be set quickly and with the utmost accuracy, for all the surfaces and motions are absolutely true with regard to the bar. A yoke of great strength braces the table, and serves as a bearing for the bar or boring arbor.

The novel features of this machine are the self-acting feeds in both directions without reversing the direction of the motion of the cone, by which the workman after having bored a hole is enabled to let the tool run back without touching the cutter, so as to remove the slight inaccuracy caused by the spring of the bar. The wide range of feeds; any feed from ¼" to ⅛" can be obtained in this machine. In the friction feed clamp machine the grip can be taken on the boring bar at any point, and, in addition, there is device for taking up the lost motion. This prevents the cutter from digging into the casting when there are high and low spots in the bore. These machines are built in four sizes, and the driving power and weight of them being proportioned to the diameter of the boring bar.

The boring bars are respectively 2⅝", 3¼", 4", 4¾" in diameter.

Fig. 2 shows a very neat design for facing bored work. The hub of the facing attachment is split, so that it can be bolted to the boring attachment at any point. When the hole in the work has been bored, both ends can be faced with the attachment without disturbing the bar or the work. The attachment can be bolted to the face plate, also, in which case the bar moves through it freely.

The tool post can be changed, end for end, from the position shown in the cut, when it will face up two feet in diameter. The attachment has been very carefully designed; it is very strong, and will take the heaviest cuts without shattering.

New Iberia, La.—The New Iberia Electric Light and Power Company has been organized. President, J. A Breaux; secretary, W. M. Gates. Capital stock, $10,000.

Westborough, Mass.—The Westborough Gas and Electric Company, of Westborough, capital $25,000, has been incorporated. The Randolph and Holbrook Light and Power Company also has been incorporated, with capital of $60,000. George H. Drew is president and Frederick S. Mordaunt, treasurer.

Newark, N. J.—The American Adometer and Cyclometer Manufacturing Company recorded articles of incorporation in the county clerk's office. The object of the company is the manufacture of electric apparatus. The capital is $10,000, and the incorporators are Wm. P. Mockridge, Geo. A. Hall and Louis Hood, all of Newark.

Lowell, Mass.—The Eastern Electric Light and Storage Battery Company, of Lowell, has been incorporated with the following officers: President, E. M. Tucker; vice-president and manager, Alfred Clarke; secretary and treasurer, J. B. French; directors, E. L. White, J. B. Currier, J. S. Dean, Boston, and F. A. Bates, New York. The company will establish its works in that city and use the Sorley storage battery.

New York, N. Y.—The Universal Arc Lamp Company, of New York City, is formed with a capital of $100,000 for manufacturing, selling and using electric arc lamps and other lamps for lighting by electricity, and the various appliances connected therewith, and authorizing others to do the same. The incorporators are Charles A. Noll, Benjamin A. Devoe and Alexander D. Keyes.

Detroit, Mich.—The Standard Illuminating Company, of Detroit; the purposes are the generating and transmitting of electricity, and the stock is 10,000 shares of $10 each. Herbert E. Deyo, trustee; John E. Wiles, Thomas Fairbairn, H. E. Deyo, Stephen W. Itsell, Edward B. Weed, Orla D. Allen and Austin S. Hatch. The company had been formed to act in conjunction with the Standard Electric Company. A central electric light station will be built at the Milwaukee junction, and a franchise secured from the council to supply houses and factories with incandescent electric lights.

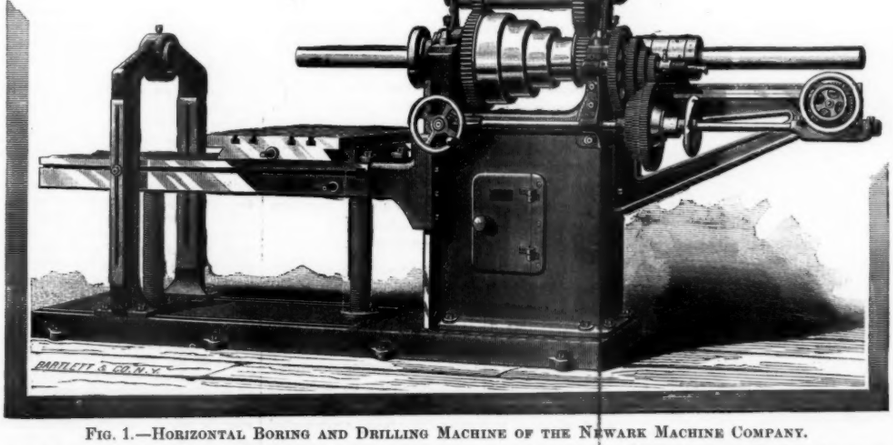


FIG. 1.—HORIZONTAL BORING AND DRILLING MACHINE OF THE NEWARK MACHINE COMPANY.

Dixon, Ill.—Dixon Electric Light and Power Company, at Dixon; to furnish light and power; capital stock, $15,000; incorporators, F. A. Watson, I. B. Countryman, and J. P. Plummer.

Sewickley, Pa.—The Sewickley Electric Company has been incorporated by Walter D. Uptegraff, J. M. Uptegraff, C. C. Wolfe, Edwin E. Little, Allen Marthens, all of Pittsburgh. Capital stock, $5,000.

Abington, Mass.—The Electric Light and Power Company, of Abington and Rockland, has been incorporated with a capital of $40,000. The president is Edward P. Reed, and Charles N. Cobb is the treasurer.

Sheldon, Ill.—Light Windmill Company, at Sheldon; to manufacture storage batteries, motors and street railway equipments; capital stock, $2,000,000; incorporators, E. Hinckley, F. G. Holton and H. F. West.

Chicago, Ill.—Metropolitan Electric Light and Fuel Gas Company, at Chicago; to operate electric light plants and gas works; capital stock, $300,000; incorporators, G. L. McKean, J. A. Medica, A. H. Kingman.

Evanston, Ill.—Evanston Electric Illuminating Company, at Evanston; to furnish light, heat and power for public and private use; capital stock, $50,000; incorporators, C. A. Byrne, L. L. Smith and E. Abbott.

Crawfordsville, Ind.—Articles of incorporation were filed with the Secretary of State by the Crawfordsville Water and Light Company; capital stock, $300,000; the directors are John S. Brown, Peter C. Somerville and Warren H. Ashley.

Wilmington, Ill.—The Secretary of State issued a license to the Henion Electric Signal Company, at Wilmington, Ill., to manufacture electric railway signals; capital stock, $20,000; incorporators, Wm. Henion, J. F. Johnson and F. R. Mullin.

St. Louis, Mo.—The Southwestern Electrical Engineering Company, capital, $10,000, filed articles of association in the Recorder's office last week. The stockholders are C. J. Briner, A. Irvine and C. R. Meston, each of whom owns 40 shares.

Cincinnati, Ohio.—The Browne Street Improvement Association, of Cincinnati, organized for the purpose of improving street railway and illumination. The incorporators are John V. Baum, Elisha Locke, Frank Moeschl, Wm. Stohl and Gustav R. Werner.

Fort Worth, Tex.—The Sherman and Denison Electric Railway and Power Company has organized with N. M. Lee, of Sherman, as president; C. W. Lewis, secretary, and A. W. Atkinson, treasurer. Work is to be started at once. The distance is about seven miles. Capital stock, $300,000.

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☞ No attention will be paid to communications without the *name and address of the writer.*

We invite correspondence from Electricians, Inventors, and the Telegraph and Telephone fraternity and those engaged in Electric Lighting, on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

NEW YORK, DEC. 14, 1889.

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"The mind of man pursues the line of least resistance," says Col. Ingersoll in a recent magazine article. This carries electricity into the realms of metaphysics. Now some one should tell us how many ohms there are in a line of thought.

Senator McPherson introduced a bill authorizing the purchase, from Stephen Vail, for $10,000, of the original telegraphic instrument used by Alfred Vail, at Baltimore, on Prof. Morse's first line. The instrument has been on exhibition in the National Museum for a year or more. The instrument used by Morse himself at the Capitol end of the line has not been preserved.

Two men in this city are posing as experts and belittling electricity, and both of them are disappointed electric light inventors. Of course this failure has nothing to do with the milk in their electrical cocoanut!

It is reported that an office sign reading "Criminals Electrocuted with Neatness and Despatch" is to be had very cheap from an alleged electrical expert of New York. It may be that the business does not promise well—but it couldn't be more of a failure than was that "Brown Converter" of a few years ago.

Senator Ingalls is the first to introduce a bill relating to the World's Fair, which appropriates $8,000,000 for purchase of site of not less than 300 acres, construction of buildings, etc. The bill does not state where the Fair will be held, but we predict that down deep in the heart of Senator Ingalls, backed by his very alert and progressive brain, the city of New York is the favorite.

An enterprising suitor in the city of Detroit proposed by telephone while his rival was waiting in the parlor for the same purpose. The telephone user was accepted, and later in the evening the proposal of the other was declined. This successful matrimonial venture opens up new fields of usefulness for the telephone, and as well speaks volumes for the excellent telephone service that Managing Director W. A. Jackson gives to the people of Detroit.

Lion-hearted Stanley, the explorer, is safe, and all journalism is proud. This newspaper boy stands at the head of an illustrious list of explorers, and his heroic services to science and civilization are unparalleled and of incalculable value. All civilized nations rejoice over his success, and his name is to-day on every tongue. The REVIEW would pay this word of tribute to Stanley, for he honors journalism and advances science as seldom falls to the lot of a single individual.

It is proposed to light up one of the darkest thoroughfares in New Jersey with electric lights. The owners of property on this desolate path now propose to rescue it from obscurity and increase the value of their possessions by lining it with electric lights. The persons interested are chiefly wealthy men, and it is not improbable that a belt of electricity about five miles long may soon light up the New Jersey woods and flash over the Passaic River. Who will say then that New Jersey is not progressive?

Mr. Carl Hering, the electrical engineer of Philadelphia, received the compliment of a banquet in his honor in Paris recently. Mr. Hering was one of the representatives at the Paris Exposition, and at the banquet had the honor of meeting a number of the electrical scientists of Paris, as well as several gentlemen from other countries, no fewer than 11 nationalities being represented at the meeting. Among the Americans present were Messrs. Bishop, of the Western Electric Company, and Meech of the Thomson-Houston Company. The proceedings and speeches were of a high order, and the occasion gave evidence of the abundance of French hospitality.

Mr. J. E. Crandall, electrician of the Chesapeake and Potomac Telephone Company, was a Washington visitor at the Electric Club Friday and Saturday of last week. The Chesapeake and Potomac Company is putting down in Baltimore a very complete system of telephone conduit made of vitrified terra cotta. Each section of conduit is divided in two divisions, each division carrying three cables, making six cables in all. Some 200,000 feet of cable is being put in in Baltimore, the cables entering the new building through a tunnel. Mr. S. M. Bryan, president of the Chesapeake Company, is one of the most progressive of telephone men, and will have a complete and modern telephone exchange system in Baltimore when this work is finished.

ELECTRICITY AND LIGHT.

The close relation which exists between electricity and light was suspected by Faraday and formed the basis of some of his most beautiful investigations. The theory of Maxwell, in regard to the electro-magnetic nature of light, has served to confirm these suspicions, but it remained for Hertz to furnish the most striking experimental proof of the identity of light and electricity. According to these wonderful experiments, light waves and heat waves only differ from electric waves in the character of their motion—all taking place in the same medium—the ether. Hereafter optics must be studied under the head of electricity, and a log fire must be considered as an electrical generator. Electricity plays a part in our organism hitherto unsuspected. According to the new theory, the eye itself is an electrical instrument. The undulatory theory of electricity now seems to have as good a foundation as the undulatory theory of light, so that there is but one more of the mysterious "actions at a distance" which remains to be explained—gravity. From its very nature, Prof. Hertz thinks that an explanation must ultimately be found, and that as a result of it all we may some day find that matter itself is simply ether in motion.

We publish in this issue a paper by Prof Hertz himself, which should be read, not only by those engaged in researches of an advanced nature, but by all who deal with electricity in a practical way.

THE BOARD OF ELECTRICAL CONTROL.

The presentment by the Grand Jury of this city against the Board of Electrical Control has evidently been the means of awakening the public to the true situation. The *Evening Post*, in an editorial on the electric wire situation, presents the severe indictment published below of this political Board. The *Post* and all other journals should know that the electrical field contains a number of capable and thoroughly independent electrical engineers, and had such men been placed upon the Board at the outset we would have been greatly in advance of the present situation. The *Post* says:

"Our difficulties have been encountered because our Board of Control has been a fantastic burlesque from the outset. We have never had in this city of absurd government a more striking lesson of the folly of putting grossly unfit men in office than we are now contemplating in the harm which this Board has done. Here was a work of the most delicate scientific nature, requiring the services of the most expert electricians who could be found; yet it was put into the hands of a butcher, a theatrical ticket-agent and a bumptious young lawyer. Not one of the three had the most rudimentary knowledge of electricity or of scientific principles of any sort. All three were chosen because they had a 'pull,' and were put into the office to make as much as they could out of it for politics. The point at which our reform should begin is with this Board, which the Grand Jury has declared to be not only grossly negligent, but incompetent. They ought to be legislated out of office the moment the Legislature meets, or removed sooner if it can be accomplished, and experts of the first rank put in their places. Then we could have not only proper subways for electric wires, but the safest kind of wires and proper and severe regulation of the strength of the current which is allowed to pass over them. That is the only way by which the lives and property of our city can be protected."

BOOK REVIEW.

"The American Railway—Its Construction, Development, Management and Appliances." Charles Scribner's Sons. New York.

This important work is worthy of abundant praise. The publishers present, in an interesting manner with a large number of artistic and striking illustrations, the experiences and opinions of many of the brightest minds familiar with railroad work. It is the only work of its kind, is brimful of new and valuable information, and illustrates and describes in a very complete manner every department of railway development, construction and management. Electricity comes in prominently in signaling, lighting and controlling trains. The Scribners have published in this a very timely work, one that will undoubtedly meet with a generous welcome.

A new electrical monthly has made its appearance in Chicago, named *Electrical Industries*. F. Willis Rice is president, and E. L. Powers, treasurer and manager. The first issue is a very creditable publication.

ELECTRICAL NEWS.

What is Transpiring in Electrical Circles in the Leading Cities.

OUR CHICAGO LETTER.

Kansas City, Mo.—The Gate City Electric Company report large sales of Okonite and electrical supplies in Kansas, Iowa and Nebraska during the past month. They have placed Mr. C. E. Wilson, formerly with the Edison Company, on the road in the above States.

The Belding Motor Company report the following sales: Women's Temperance Pub. Co., 7½ h. p. motor; C. L. Palmer, Chicago, 7½ h. p.; N. T. West, Milwaukee, 10 h. p.; Consumers' Gas Co., ½ h. p.; Chambers & Co., ½ h. p.; United States Pub. Co., ½ h. p.; Admandson & Kirchmer, 1 h. p.; Chicago Model Works, 1 h. p.; Fowler Bros., 2 h. p.; S. Himan, 1 h.p.; J. C. Cosgrove, ½ h. p.; City of Carroll, Iowa, 5 h. p. to be used for pumping water for city use. The 7½ h. p. motors lately installed are the first large motors ever built by this company and are giving excellent satisfaction. They are now preparing patterns for a 15 h. p. motor which will soon be placed on the market.

The Ft. Wayne Company.—The Chicago office of the Ft. Wayne Electric Company report the following sales the past week: East St. Louis Electric Light and Power Co., 100 arc, 500 alternating incandescent; Swift & Co., Chicago, 1,000 alternating, increase; Swift & Co., Kansas City, 60 arc, 1,200 alternating incandescent, increase; Swift & Co., Omaha, increase, 25 arc; Manhattan Electric Light Co., Manhattan, Kansas, 25 arc, 500 alternating incandescent; Central Electric Light Co., Chicago, 2,000 alternating incandescent, increase; Allen Building, Chicago, 500 alternating, 25 arc; Cribben, Sexton & Co., 300 incandescent, direct; Armour Packing Co., Kansas City, 1,200 alternating; Page & Co., Chicago, 60 incandescent, direct.

Personal.—Among the late visitors at the REVIEW office were Mr. Paul Seiler, who was accompanied by Kwong Yuen and Wong Yang, two Chinese merchants of San Francisco, and stockholders in the Canton Electric Light Company, Canton, China. Before leaving San Francico these gentlemen purchased of Mr. W. C. Clark, agent of the Westinghouse Company, two 500-light alternating machines. The party are on a tour of inspection, and will visit all of the principal electric manufacturing companies before their return to the coast.—Geo. B. Shaw and Walter K. Freeman are visitors in the city.

Train Lighting.—Mr. Wm. Hood, western agent for the New York Accumulator Company, to-day ordered for the Chicago, Milwaukee and St. Paul Railway 120 cells, 23 M type rubber jars, to be shipped by express. These cells, packed, weigh about 50 pounds each, the entire shipment about 6,000 pounds. The above cells are to be used by this road in lighting their trains.

Auditorium Plant.—To-day the finishing touches will make everything in readiness for the grand opening which will take place on Monday, the 9th inst. The work of installing this plant has taken many months, and for its successful finish great credit is due Mr. G. D. Hand, the electrician in charge for Leonard & Izard. A slight idea of the immense amount of work done can be had when the following facts are taken into consideration: The stage lights number 1,700, in three colors, viz: red, green and white; 250 in the dressing rooms, which are located on both sides of the stage; the theatre proper contains 2,300 lights; all lights will be operated and controlled from the swinging switchboard located on the left of stage.

A number of electrical appliances arrived this week from Hamburg, Germany, to be used in producing stage effects, such as rainbows, lightning, moon, sun, etc.

The figures given above include the theatre lights only; when the lights in the box office, manager's office, entrances and basement of theatre are taken in it gives a grand total of 5,450 lights.

Ames, Crerar & Co., northwestern agents of the Western Electric Company, have opened a general supply store for electrical goods at 51 East 4th street, St. Paul. They will keep in stock a full line of electrical supplies, including insulated wires, linemen's tools, switches, cut-outs, incandescent lamps, electric bells and annunciators, batteries, etc., etc. They will also give attention to construction work and will have a competent force of men to undertake all kinds of electrical contracts, such as central station and isolated electric light plants, fire alarm and call bell systems. Mr. B. L. Ames, who will have personal supervision of the business of the concern, is a graduate of the Massachusetts Institute of Technology and has had several years experience as manager of successful electric light plants, both arc and incandescent.

Electricity for Emergencies.—During the month of August last, a fire occurred in the building, one side of which is occupied by the Curray Mfg. Co., color grinders. Through

the efforts of the fire department the fire was confined to one side of the fire wall. A portion of this wall fell, crushing through the roof of the engine and boiler house of the above company, completely burying their engine and boilers. Being left without power it was thought necessary to shut down, when the idea presented itself to apply to the Sperry Electric Co., who are directly opposite, for power. This latter company quickly responded, and furnished 17 horse-power in a novel way. Taking one of their 20-light shunt-wound arc dynamos, they placed it in the factory of the Curray Manufacturing Company, placing a similar machine in their own factory and furnishing power to it from their own shafting. They transmitted the desired power and ran same for a period of six weeks with the loss of but one day, that being the day after the fire. D. B. D.

Chicago, Dec. 7th.

OUR BOSTON LETTER.

Mr. H. C. Spaulding, general manager of the Thomson-Houston Motor Company, left on Friday evening for a flying trip to the West. Chicago and Cincinnati are on his visiting list.

Looking Up Overhead System. — Mayor Palmer, the Lowell Board of Aldermen and other invited guests were in Boston last Monday, upon invitation of President Whitney, of the West End Company, to inspect their electric railway system.

Sandwich Glass Company.—It is understood that the time by which the Electrical Glass Company, of Boston, was to make the first payment for the works of the Boston and Sandwich Glass Company has been extended 10 days.

Squadron Party in Lynn.—When it was learned that the squadron of evolution was to visit Boston, the managers of the Thomson-Houston electric works arranged that the admiral and officers of the fleet should be invited to inspect the plant. In this movement the managers of the Thomson welding works co-operated. The distinguished guests were received Tuesday morning. A committee from the works met Gov. Ames, the naval party, and other guests in Boston in the morning, and escorted them to a special train on the Boston, Revere Beach & Lynn Railroad. Upon their arrival at the Market street station, at 10.30 A.M., a trip over the burned district in a tally-ho and three barges was made in the route to the Thomson welding works. The guests were received at the works by Henry A. Pevear, president of the Thomson-Houston Electric Company; Joseph N. Smith, president of the Welding Company; Benjamin F. Spinney, Charles A. Cohen, Burton Sturges, E. W. Rice, superintendent of the Thomson-Houston electric works; H. A. Royce, general manager of the welding works; Col. J. N. Campbell, a former private secretary of Gov. Ames, and now with the Thomson-Houston Electric Company, and H. W. M. Wood, of the Welding Company, formerly of the United States Army.

C. H. McKenney & Co. are putting a very tasty electrolier in Mr. Frank Ridlon's private office.

Boston Electric Club —The first address of the season before the club was given last Tuesday evening by Mr. Alex. P. Wright, general manager of the Wright Electrical Engineering Company, on "Underground Conduits." The lecture, which was of a very practical nature, was well illustrated with sketches and diagrams of various systems of underground construction.

Professor Trowbridge's lecture on the "Nature of Electricity" was listened to with marked attention by a large and cultivated audience in the lecture-room of the Jefferson Physical Laboratory, Cambridge, last Monday evening. This lecture was one of a series inaugurated by the Harvard Electric Club, which now numbers about 50 students of Harvard University.

Trip to Lynn.—On Wednesday last, the Boston Paper Trade Association was handsomely entertained by the Thomson-Houston Motor Company. A trip to the company's factories at Lynn was the event of the day. Mr. H. C. Spaulding and Mr. O. S. Hussey were in charge of the party which numbered about 35. A special car on the Boston and Maine Railroad conveyed the party to Lynn. On arriving at the factories, three or four sections were formed and each consigned to the care of an able courier. After a thorough inspection, the party was conveyed in a barge to the Boston, Revere Beach and Lynn Railroad, where another special car was in waiting to convey them to the "Strathmore," at Revere Beach, for dinner. When this subject had been fully discussed, the trip to Boston was resumed, and on the way in a hearty vote of thanks was given the company for their hospitality.

Improvised a Search Light.—A missing marine was badly wanted on the warship "Chicago" one night recently. The police were notified, and, as they had been very handsomely treated by Admiral Walker, they were anxious to accommodate him, if possible. Capt. Larry Cain, of Division 1, was determined to find the missing corporal if he was in the North End, and a general alarm was sent out to all the officers on their routes by means of the signal boxes. The captain decided to take a hand himself, and rigged up a search light. The storage batteries were secured by him and these were rigged up with carbons, and carried about the North End. This novel apparatus, which was used for the first time for police duty, was brought to bear upon every dark hole, alley way, street and cellar upon the district where it was thought possibly the missing corporal might be in hiding. It was a big thing, and a light equal to the sun was shed upon every dark hole. The missing corporal could not be found, and the search was given up. It was decided, however, that the search light was a valuable adjunct, and it is probable that several of the stations will be supplied by these upon the recommendation of Capt. Cain.

Lowell.—On Friday evening the board of aldermen gave a final hearing on the petition of the Lowell and Dracut Street Railway Company for permission to use electricity as a motive power. Mr. Samuel Powers made the argument for the company, F. W. Qua represented the remonstrating citizens, and Hon. George F. Richardson appeared for the petitioners.

E ec ric Railway Sweeper.—The Thomson-Houston Company are just completing seven new snow plows and sweepers for the West End Company, of Boston. They are designed to be used on the electric lines and are similar to the old ones drawn by horses.

Boston, Dec. 9, 1889. S. L. C.

OUR ST. LOUIS LETTER.

Electric Light Sale.—In the past two weeks brokers, acting for the Hollins & Co. syndicate, of New York, have bought the greater portion of stock in the Laclede, St. Louis, Water and Carondelet Gas Companies, together with the electric light plants of the Heisler and Thomson-Houston Companies. It seems evident from this that the Hollins Company intend to control the lighting of this city. The remaining stockholders of the St. Louis Gas Company, to realize the most on their stock, have advertised it for sale on Dec. 24. It will undoubtedly be bought in by Hollins & Co.

Fighting for Electricity.—A sharp fight is in progress between the Lindell Avenue R. R. and the residents of Delmar avenue over the proposed electric system for that avenue. A few of the residents have had circulars distributed, urging their neighbors to resist the ordinance now before the City Council, granting a franchise to the Lindell Avenue R. R. To add to the difficulties with which this road is contending, one of the wires on the electric division broke and, coming in contact with a telephone wire, burnt out 19 Bell telephones, which were distributed in that neighborhood. At present hot debates are being carried on before the Street R. R. Committee of the Council, with no settlement as yet. The Lindell R. R. is still running its cars on the western division by electricity.

Another Trial.—Mr. Sidney H. Short, of the Short Electric Railway system, has arrived here to superintend in person the experiments now being tried on the south end of the Broadway line. This line has been experimenting with this system for the last year. On the first trial, to give it a severe test, the poorest track and heaviest grade on the line were given to the Short people. The result was not entirely satisfactory to the railway company, who refused to accept the motor. With this Mr. Short offered to stand the expense of a second trial, at which all the latest mechanical devices were to be used. This offer has been accepted, and in accordance with the contract a 250 horse-power Wheelock engine, two powerful dynamos, new poles and wires, together with a new track of 78 pound steel Johnson rails have been put in position. The Brush Electric Company, who are backing Mr. Short, are putting dynamos into eight new cars and, on their arrival, the system will be given a second test. The South Sixth street line have received ten new electric motor cars, and as soon as their new steel rails are received and laid, will operate entirely by electricity.

Crossing the Bridge.—The electric road on the St. Louis Bridge will be put in operation on Sunday, December 1st. It will, for the present, run only from Third street, of St. Louis, to about 200 feet beyond the East Side approach, but it is the intention to extend it as far as the stock yards, a distance of about two miles.

Personal.—Wm. B. Farrar, secretary of an electric light company in Chicago, Ill., is in the city.—Mr. Charles Heisler, who has been attending to his electric display at the Paris Exposition, has returned.—Mayor Bartel, and the city council of Belleville, Ill., are visiting this city for the purpose of examining the method employed in lighting the city by electricity, as it is the intention to light Belleville similarly.—Mr. Hector Campbell, a practical electrician of Niagara Falls, N. Y., is spending a few days here.

Since writing the above, Mr. Mortimer F. Taylor gave me the information that Hollins & Co. were not acting on their own account in purchasing the gas and electric light companies of this city. In respect to the gas companies, they were buying in the interest of Rockefeller & Gibbs, of Philadelphia, and the Standard Oil Company, and that their intention was not to increase the price of gas. Mr. Taylor was not of the opinion that the same parties controlling the gas companies had bought the electric light plants of this city, but who the parties were he was not able to say. W. H. B.

St. Louis, Dec. 7.

OUR WASHINGTON LETTER.

The Underground Wires.—In their annual report to Congress, the Commissioners of the District of Columbia report, in regard to underground wires, that during the year preceding November 1, 1889, the United States Electric Lighting Company laid 14 miles of arc light conductor; the Chesapeake & Potomac Telephone Company, 19 miles, and the Postal Telegraph Cable Company constructed a conduit from its main office to the city boundary, about 2½ miles. This last named was laid to replace a section of Barrett conduit, made of small paper tubing into which bare wires were drawn, which did not prove successful. Major Raymond recommends that the telegraph companies be given one year to place all their wires underground, and be required to pay an annual license of $25 for each pole maintained within the city after the expiration of that time.

Electric Light Wanted.—The subject of electric lighting is agitating the village of Laurel, Md., which is half way between Washington and Baltimore, on the B. & O. R. R., contains 2,500 inhabitants, has eight miles of streets, a cotton factory employing 250 operators, and several other mills. There are no gas works in the place. The commissioners of the village are making inquiries as to the cost of a plant which will furnish arc lights for outdoor and incandescent lights for indoor use. There is a strong feeling in favor of a plan by which the corporation shall own and operate the plant, although some of the leading men prefer that the work shall be done by a private company. There is available water-power, but whether sufficient to operate the necessary dynamos has not been determined

Proceedings in Congress.—Among the very first bills introduced was one by Senator Call, directing the Commissioners of the District to advertise for proposals to furnish the city of Washington and the public buildings of the city with gas and electric lights, or either, for a term of not less than five years, also for a term of not less than ten years, and authorizing the Commissioners to contract with the lowest bidder, after contracts have been approved by the Secretary of the Treasury and by Congress. This scheme is too impracticable, so far as it relates to electric lighting, to leave any hope that it will become a law.

A proposed amendment to the Eckington railway charter authorizes that company to extend its road about one mile further into the heart of the city, passing the Patent Office and terminating at the Treasury Department, on condition that if electric wires are used, they shall be placed underground. The bill also authorizes an extension of the road, with overhead wires, a short distance in the country. The company's capital stock will be increased $100,000.

Besides a bill has been presented granting a charter to a new company to be called the Georgetown and Kendall Green Railroad Company. The incorporators are Henry A. Willard, Jeremiah Wilson, Edward G. Stellwagen, Geo. E. Hamilton, Thomas M. Gale and J. J. Darlington, of Washington; Philip E. Chapin, of Pennsylvania, and ex-Senator W. P. Kellogg, of Louisiana. Kendall Green is the name of the Deaf-Mute University, in the extreme eastern part of the city, and the company proposes to build from that point through the center of the city, by two routes, to the heights of Georgetown. About eight miles of road will be required. The charter authorizes the use of horse, cable or electric power, and the capital stock is $500,000 with the privilege of increasing to $750,000. If electric power is used, it must be by means of storage batteries or underground conduits.

Thomson-Houston Headquarters. — The Washington office of the Thomson-Houston Company is at No. 1333 F street and is in charge of Paymaster Frank H. Clark, of the United States Navy, who has been granted a year's furlough to engage in this business.

Washington, D. C., Dec. 6. G. C. M.

In the suit of the Electrical Accumulator Company *vs.* the Gibson Electric Company, in the United States Circuit Court for the Southern District of New York, which was instituted in February last, the complainants have recently moved for a preliminary injunction, and Judge Lacombe recently granted the motion, and the injunction issued. The complainants claimed that the testimony conclusively showed that the Gibson Company had continuously infringed the Faure patent, and that the various modifications were also infringements.

PERSONAL.

Mr. F. W. Harrington, of the Western Electric Company, headquarters in Boston, was a visitor last week to New York city, and registered at the Electric Club.

Mr. F. W. Jones, of London, England, general manager of the West Coast Telephone Company, is visiting in New York City, and making his headquarters at the Telephone Building, 18 Cortlandt street.

Mr. Nikola Tesla, the electrical inventor, has returned to this country from an extended visit in Europe. Mr. Tesla is much improved in health by his vacation, and more good work in electrical science may be expected from him.

Mr. W. H. Fitzgerald, of Detroit, who is prominently identified with the electrical interests of that city, was a visitor in New York last week. Mr. Fitzgerald reports the general electrical industry in his city, and the West generally, as being quite active and progressive.

Mr. H. M. Byllesby, vice-president of the Westinghouse Electric Company, and Mr. Leonard E. Curtis, attorney of the same company, returned to New York from London last week. They have been in the latter city for several weeks organizing the Westinghouse Company there, where a great business in electric lighting is evidently assured.

Dr. George H. Benjamin, the electrical engineer, has returned to New York from a very extensive trip over the continent of Europe. Dr. Benjamin thoroughly investigated the underground systems, and, while not convinced that Europe has the best work in this line, thinks that all electric wires can be very successfully worked underground.

Mr. W. H. McKinlock, president of the Central Electric Company, Chicago, and vice president of the Electric Club of that city, is spending the week in New York, a guest at the Electric Club on 22d street. The Central Electric Company, under Mr. McKinlock's progressive management, has become one of the leading electrical houses of the country, and is crowded with business.

Mr. Fred. W. Royce, of Washington, D. C., whose inventive genius has been somnolent for nearly a year past, is said to be at work at the present time upon some very important improvements in the direction of electrical cooking. Some of his friends make bold enough to announce that a lecture may be expected from him at an early day entitled, "How to Fricassee Chicken by Electricity."

State Electric Light Association.

TO THE EDITOR OF ELECTRICAL REVIEW:

A meeting of the central station companies doing business in the State of Maryland and the District of Columbia was held to-day, for the purpose of organizing a State association. Invitations to attend this meeting were sent to every central station company in the State and District by the secretary of a preliminary meeting held November 13th, 1889, for the purpose of determining the advisability of organizing a State electric lighting association.

When the meeting came to order it was found that those present are operating apparatus made by the following manufacturers:

1. Brush Electric Co.
2. Heisler Electric Light Co.
3. Thomson-Houston Electric Co.
4. United States Electric Co.
5. Westinghouse Electric Co.
6. Waterhouse Electric Co.

The aggregate capitalization now invested in electric central stations in Maryland and the District of Columbia is estimated at $3,250,000. There was represented at this meeting a capitalization of about $1,630,000, which is over one-half of the entire investment in the State and District. Telegrams and letters were read from companies not represented, expressing their approval of the movement, and their intention of becoming members of the Association as soon as it was organized.

The Association was organized under the title of "The Electric Light and Power Association of Maryland and the District of Columbia." By-laws were adopted and the following officers were elected:

President, J. F. Morrison; vice-president, H. G. Fledderman; executive committee, J. F. Morrison, W. T. Biedler, James B. Macneal, John Mason.

One vacancy was left in the executive committee to be filled by a representative of one of the Washington companies.

The office of the Association is established at 15 South street, over Franklin Bank, Baltimore, Md., which is the official address of the secretary.

The preparatory work of organization is about completed in a large number of States. It is expected that the movement will develop rapidly from this time forward, until all States are organized. A. R. FOOTE,

Chairman National Committee on State and Municipal Legislation of the N.E. L. A.

Baltimore, Md., Dec. 5th.

Telephonic News

*** The people of Newark, Ohio, are well pleased with the new copper circuit connecting them with other cities. The telephone service in that part of Ohio is very satisfactory.

*** The Canadian Electrical Society propose to hold an invitation conversazione during the winter, at which several interesting exhibits will be displayed and explained to visitors, such as the telegraph, telephone, fire alarm, electric light, phonograph, medical electrical apparatus, etc.

*** At a recent meeting of the Mexican Northern Telegraph and Telephone Company, the following directors were elected: John W. Weed, Winthrop Pond, William T. Patterson, Robert Colgate and John J. McGinty. Mr. Weed will be elected president and Mr. McGinty secretary, at the first meeting of the Board.

*** The Pacific Telephone Company, of San Francisco, has purchased the Mercantile Library building on Bush street, between Sansome and Montgomery, for $157,000, and will make it a six-story brick building. The library will occupy it for about a year. The alterations will cost over $50,000. The telephone company proposes spending $150,000 in underground conduits; and will also put in a new switchboard costing over $100,000.

*** Frank E. Maize, of Philadelphia, telephone operator at the central police station at that city, has been appointed inspector of the electrical department. The position was made vacant by the death of Robert Gillan. Mr. Maize is known as a capable Morse operator. He comes from a family of electricians, one of his brothers being a Western Union chief. Elmer J. Titus, an inspector of the Bell Telephone Company, will succeed Mr. Maize.

*** The annual meeting of the stockholders of the Continental Telephone Company will be held at 95 Milk street, December 11, 1 P. M., for the election of officers and other business. This will be the last annual meeting of this company and it will proceed to wind up and dissolve. The Tropical American Telephone Company succeeds it. The last-named company is the sole legal export agent of Alexander Graham Bell *et al*, from the United States of America to the Republic of Brazil.

*** The telephone company that was organized along the line of the Gulf and Chicago Railway to build a telephone line from Ripley to Houston, Miss., a distance of 73 miles, has completed the work from Ripley to Memphis, Tenn., and the line between these points is now open for the use of the public. The company is pushing the project, and will in a few days have the entire line completed. This will be a great convenience to the people along the line of the Gulf and Chicago, who have heretofore had no means of communicating with the outside world.

The St. Louis Exchange.

Chief Operator Casey, of the St. Louis Telephone Exchange, stated in a recent interview that the total number of subscribers served at that exchange is 3,500.

The average number of calls answered and connections made daily is about 60,000, and very frequently as many as 70,000 connections are made in one day, the busiest season being invariably between the hours of 9 A.M. to 11 A.M., and 3.30 P.M. to 5 P.M.

The exchange is provided with lightning arresters, which guarantee immunity from lightning, also from electric light currents.

Mr. Casey also stated that their new building now under contract, when completed, will increase the present capacity of the exchange, which is 4,600 wires, to 9,600, giving St. Louis one of the largest and best telephone systems in the country.

Identity of Light and Electricity.

PAPER READ BY PROFESSOR H. HERTZ, AT THE MEDICAL CONGRESS IN HEIDELBERG, SEPTEMBER, 1889.

In speaking of the relations between light and electricity, it might be thought at first that this was a question referring to electric light. But this is not the object of the present paper. If the reader is a physicist, he might think of the reciprocal and very delicate actions of the two forces, such as the rotation of the plane of polarization by the current, or the variation of resistance of a conductor under the influence of light. In all these cases the action is not direct or immediate; between the two forces there is an intermediary, ponderable matter. These phenomena do not in this instance occupy our attention. Other relations exist between these two forces closer and more intimate than those we have mentioned. The proposition which will be enlarged upon in this paper is the following: *Light is an electric phenomenon in its very essence; the light of the sun as well as that of a candle or of a glowworm. Suppress electricity in the universe, and light disappears; suppress the luminiferous ether, and electric and magnetic forces no longer exert any influence through space.* Such is the thesis which will be supported here. It does not date from yesterday or from to-day; its history is long and instructive.

My own experiments only mark one of the stages of development of this theory, and it is this development altogether—not one of its phases only—that I would bring before you. But it is not easy on such a subject to be clear without omitting anything essential.

The phenomena in question occur in the empty space in the very midst of the ether. They are sensible neither to touch, nor to smell, nor to sight; they are accessible to our thoughts and our reasoning, but it is difficult to describe them accurately. We will, therefore, endeavor to connect them with certain known facts, and, for this purpose, will recall what we know concerning light and heat before attempting to establish a relation between these two forces.

What is light? Since the researches of Young and Fresnel we know that it is an undulatory movement. We know the speed of the waves—their lengths; we know that they are transverse waves; in one word, we are acquainted with all the geometrical conditions of the movement. All these facts are absolutely incontestable and removed beyond all doubt. The theory of undulation is, humanly speaking, certain, and all that follows from it is likewise certain. It is, therefore, certain that all space which is accessible to us is not empty, but filled with a substance capable of entering into vibration—ether.

But if we possess very clear notions on the geometrical condition of the phenomena which occur in this medium, their physical nature, on the other hand, is very obscure, and what we know of the properties of the substance itself is full of contradictions.

Comparing luminous waves with sonorous ones, they had been considered as elastic. But, in fluids, elastic waves only occur in the form of longitudinal waves. Transverse elastic waves are impossible in fluids; the very nature of matter is opposed to them. The admission that the ether behaved like a solid body was, therefore, compulsory. On the other hand, on recalling the movement of the heavenly bodies, we were compelled to affirm that the ether acted like a perfect fluid. The rapid development of optics is altogether an astonishing fact in view of the flat contradiction offered by these two propositions.

Without trying to hide this difficulty, let us pass on to electricity; maybe its study will enable us to circumvent this obstacle.

What is the nature of electricity? This is a very arduous problem and one which excites interest far beyond the limited reach of the scientists. Most of those who ask themselves this question, do not doubt the existence of electricity; they expect a description, an enumeration of the properties and qualities of this singular substance. For the scientist the problem assumes another form: Does electricity really exist? Are not electrical phenomena, like others, traceable to the properties of the ether and of ponderable matter? The state of our knowledge does not enable us as yet to answer this question in the affirmative. Materialized electricity still plays an important part in our conceptions, and there is still preserved in current language the ancient and familiar idea of two electricities which attract or repel each other, and to which we attribute actions at a distance which resemble intellectual qualities.

The time when this theory was formulated was the moment when Newton's law of gravitation received such a striking confirmation in astronomy, and the idea of an action at a distance without any intervening medium was familiar to the mind. Electric and magnetic attractions obeyed the same laws as gravitation; therefore, in admitting a similar action at a distance, the phenomenon seemed to have been explained in the simplest and most satisfactory fashion. All this was altered when, in the present century, the reciprocal action of currents and of magnets was discovered, an action variable *ad infinitum*, and in which motion and time play such an important part. The number of actions at a distance had to be enlarged, their theory had to be perfected. But at the same time disappeared the simplicity of the system which gave it its scientific probability. An attempt was made to return to this simplicity by seeking simple formulæ, elementary and general laws. Weber's celebrated law is the most important attempt in this direction. Whatever we may think of their correctness, these attempts were made in the interests of a system which is full of attractions. It was impossible to get outside this magic circle after having once entered it. The road which was followed could never lead to truth; but to resist the current great freshness of mind was required; these phenomena had to be considered without any preconceived opinion, and one had to start from facts observed and not from what he had heard, read, or learned.

Such was the road followed by Faraday; he had heard it stated that, by electrifying a body, something new was introduced into it; but he saw that the changes observed were only external and not essentially changes modifying the nature of the body. He was taught that the active forces only traversed space, but he remarked that the nature of the matter which filled this space had the greatest influence upon them. Faraday had read that electricities existed and that their properties only were discussed, and yet he daily observed the effects of these forces without ever seeing anything of the electricities themselves; he therefore proceeded to reverse the proposition. The electric and magnetic forces became for him the only tangible reality; electricity, magnetism descended to the rank of objects whose existence is very contestable.

Considering these lines of forces, as he calls them, he saw them as they manifested themselves in the form of potential, of eddies, of currents, without troubling himself with the question what they really might be. It was sufficient for him to have established their existence, to watch their mutual effect upon one another, to see them carry material bodies along with them, and propagate themselves by transmitting excitation from one point to another. To the objection that in an empty space there can be no other condition but that of absolute rest, he might reply with the questions: Is there really such a thing as empty space? Does not the transmission of light compel us to consider it filled with matter? Cannot the ether which transmits luminous waves undergo modifications which we perceive in the form of electric and magnetic actions? Is there no relation between these modifications and these vibrations? Are not the luminous waves like the scintillations of these lines of force? Such were the hypothesis arrived at by Faraday, and to the scientific demonstration of which he applied himself with all his ardor. Researches on the relations between light, electricity and magnetism became the favorite object of his studies, and age alone set a term to his investigations.

One of the principal questions which occupied him was to know whether the transmission of electric and magnetic forces was instantaneous or not.

When the current excites an electro-magnet, is the magnetic field established instantaneously to the very limits of space? Or, rather, does the action first reach the nearest points, and only gradually spread to remote points? If we modify rapidly the electric condition of a body, do all the points of space simultaneously obey the same variations, or, rather, is there a retardation, more or less great in proportion as the distance increases? In this latter case the effect of the variation would be transmitted through space like a wave. Do these undulations exist? Faraday did not succeed in answering these questions, and yet his theories have a direct bearing upon their solution. If there exist electric waves traversing space, the independence of the forces which produce them is demonstrated. We know that these forces do not traverse space instantaneously, for we can, from one moment to the next, follow their propagation from one point to another. The problems which Faraday set himself, so far from being insoluble, require but very simple experiments to be solved. If it had been vouchsafed to him to imagine these experiments, his theory would have triumphed from the outset. The relation between light and electricity would immediately have become so evident that it could not have escaped even a less practiced eye than his. But it was otherwise ordained. Experiments at first afforded no solution, and the prevailing theory was opposed to Faraday's ideas. By affirming that electric forces can exist independently of corresponding fluids, he contradicted the system generally admitted at that period. Moreover, the idea that the nature of luminous waves could be anything but elastic, was rejected in optics. It seemed as if a discussion of either of these hypothesis could only be a sterile speculation. The deepest admiration we, therefore, owe to the man who knew how to bring into such agreement these two hypothesis apparently so far removed from one another that they lent each other mutual support, and served as the basis of a system, the likelihood of which could not be denied. This man was Clerk Maxwell. His work, published in 1865, is known under the title, "Magnetic Theory of Light." It is impossible to study this theory without sometimes having a sort of sensation as if the mathematical formulæ were endowed with real life and special reason. They seem sometimes more intelligent than we ourselves, more intelligent even than the one who has established them; they hold more than he promised. This is not at all impossible; it is always the case when formulas are true beyond what is known in establishing them. But formulas so comprehensive could only be found by seizing upon the least particle of truth of which nature allows us a glimpse. We know the light which guided Maxwell. It is a phenomenon which had already struck other observers, and which Riemann and Lorenz had already made the object of similar, but less successful, hypothesis. This is it: Electricity in motion produces magnetic forces; magnetism in motion produces electric forces; these effects are only appreciable with very high speeds.

The factor of speed, therefore, enters into the relation which connects electricity and magnetism, and the constant which determines this relation, and which always re occurs in it, is itself a speed of enormous magnitude. The speed of electricity had been determined in different ways, first by Kohlransch and Weber, by means of purely electric experiments; and these extremely delicate researches had proved that it is equal to another remarkable speed—that of light. This could not be a mere coincidence, and Faraday's disciple Maxwell discerned that it must be owing to the fact that both electric forces and light are transmitted by the same medium—the luminiferous ether. The two speeds, which had been determined almost at the same time, could not be but equal, and the most important optic constant was from that moment introduced into electric formulæ. Maxwell strengthened this bond between the two classes of phenomena; he enlarged the formulæ so as to make them express, not only all the known phenomena, but, in addition to these, a whole class of hypothetical facts—electric undulations. He considered them as transverse waves, whose wave length might be of any magnitude, but which would be propagated through the ether with a constant speed—that of light. Maxwell then was able to show that there really exist in nature undulations possessing these geometrical properties, although we may not be in the habit to consider them as electric phenomena, and give them a special name—that of light.

If we reject Maxwell's electric theory, we have no longer any reason for admitting his ideas with regard to light. In the same way, if we contend that light is a phenomenon of elastic nature, his theory of electricity becomes impossible. But if we study his system, without reference to current theories, the different parts will be seen to lend each other mutual support, just like the stones of a vault, and the whole seems a gigantic arch spanning an unknown region, and uniting two recognized truths. It is true that the difficult nature of the theory did not at once secure for it a large number of followers; but having once grasped its real meaning, one is bound to follow it up to its last consequences, and then only realizes the importance of its fundamental hypothesis. Experimental research was for a long time confined to some isolated propositions on the accessory parts of the theory.

I have likened Maxwell's system to an arch which spans an abyss of unknown things. If I may be allowed to revert to this image, I would say that, to strengthen the vault, one could for a long time only strengthen its two buttresses. Thus it was enabled to support itself, but its span was yet too large to erect on it, as a solid foundation, a new structure. To accomplish this, pillars rising from the ground must support the very center of the arch. The demonstration of the possibility of obtaining directly electric or magnetic effects from light would have constituted one of these pillars and confirmed the theory. This discovery would have strengthened immediately the optical part of the theory, and indirectly also the electrical part. The demonstration of the existence of electric or magnetic waves, propagated after the fashion of luminous undulations, would have constituted another argument of the same importance. It would have confirmed directly the electrical, and indirectly the optical, part. The completion and the symmetry of the structure require the erection of two pillars, to which we liken these principles, but a

single one suffices for our first needs. The construction of the first has not yet been attempted; as to the second, after many researches, a solid and ample foundation has been laid for it; part of the pillar already rises above ground, and, thanks to the co-operation of a crowd of workers, it will soon reach the summit of the vault, and will enable it to support the weight of the structure which is to be built on it.

I have been fortunate enough to take part in this portion of the work, and it is to this circumstance that I owe the honor of submitting to you to-day my investigations; you will pardon me, therefore, if I proceed forthwith to call the attention of my hearers to that particular part of the structure. Unfortunately I shall be prevented by lack of time from entering upon the researches of a large number of explorers, and I shall not be able to show to what extent my experiments had been prepared by my predecessors, and how near some of them had even come to a definite result.

Was it really so difficult to demonstrate that the propagation of electric or magnetic forces was not instantaneous? Should it not be possible to discharge a Leyden jar, and to observe if the oscillation of a distant electro-scope was produced with a certain retardation? Should it not suffice, for the same purpose, to observe a magnetic needle whilst an electro-magnet was being excited at some distance? In fact, these and similar experiments have been made, without, however, being able to prove that an interval of time elapses between the cause and the effect.

For a follower of Maxwell's theory this failure is inevitable, and arises from the enormous speed of transmission. We can not watch the discharge of a Leyden jar, the excitation of a magnet beyond a moderate distance, say of 10 metres. Now, light, like electricity, according to the theory, traverses this space in one thirty-millionth part of a second, and such a short interval of time can be neither observed nor measured directly. Moreover, we do not even possess any signal for clearly marking such an interval. When we wish to take a length measure up to one-tenth of a millimetre, we do not mark the commencement with a large chalk mark. If we wished to determine time to within one-thousandth of a second, it would be absurd to mark the beginning by sounding a big bell. The time necessary for the discharge of a Leyden jar is, for our ordinary means of observation, infinitely short. This does not mean that it is not equal to one thirty-millionth of a second; and in our case this would be more than a thousand times too long. But nature has supplied another expedient. It has been known for a long time that the discharge of a Leyden jar is not uniform, but is composed, like the sound of a bell, of a number of vibrations, of partial discharges succeeding each other at very regular intervals. Electricity is therefore capable of imitating elastic phenomena.

The duration of each vibration is very much shorter than that of the total discharge; one vibration may therefore be taken as a starting point. Unfortunately the shortest vibrations observed are of one-millionth of a second. During the duration of such a vibration its effect is propagated to a distance of 300 metres, and in the limited space of a laboratory it would appear simultaneous with the vibration. The known phenomena, therefore, could not assist us, and we were obliged to find another way. What enabled us to circumvent the obstacles is the fact that it is not only the discharge of Leyden jars which produces vibrations, but that the same phenomenon occurs in any conductor whatsoever; under certain conditions these vibrations may even be much more rapid than those of the Leyden jars. On discharging the conductor of an electric machine, vibrations are produced whose duration varies from 100 to one thousand-millionth of a second. These are, it is true, only isolated vibrations dying away rapidly, and we have here an unfavorable condition for the experiment.

But success would be possible even by observing only two or three of these vibrations. Thus, in the domain of acoustics, we replace, if required, the long-stretched sound of whistles and of cords by the short signals of wood (resonators).

We thus possess signals, in comparison with which the thirty-millionth part of a second is no longer a short interval. But they would be of little use to us if we were not able to discern them at the assumed distance of 30 metres. The means employed for this purpose is very simple. At the spot where we wish to observe the signal we place a conductor—for instance, a straight metallic wire with a short breakage at a given point. When the electric field varies rapidly a spark appears in this conductor. This means of observation could only be indicated by experience; from the theoretical point of view it was difficult to imagine. In fact the sparks are microscopic, hardly one-hundredth of a millimetre long; their duration is less than one-millionth of a second. It seems impossible—almost inconceivable—that they should be visible, and yet they are so in a dark room and for a steady eye. Such is the slight thread on which hangs the success of our undertaking.

We have, in the first instance, a number of questions to solve. Under what conditions are the vibrations strongest? These conditions must be fulfilled. What form ought we to give to the conductor? According as we employ straight or bent wires, or conductors of different shape, the phenomena vary. If the form of conductor is established, what size shall we give it? This is not indifferent, for we soon find that we cannot with one and the same conductor study any vibrations whatsoever; that there exists a relation between these two factors, which reminds us of the phenomena of resonance in acoustics. Finally, how many different positions can we give to this conductor? At one time we shall see the sparks increase in strength, at another they will become weaker, and finally disappear altogether. I do not wish to enter upon all these details, although they are essential factors for the success of the experiments. On the knowledge which the experimenter has of the means at his command depends the result of his experiments. A thorough acquaintance with the instruments, *i. e.*, the solution of the above questions, was, therefore, the most important part of my work. When this task was done the solution of the problem followed by itself.

Give a physicist a certain number of tuning forks and resonators, and ask him to prove that the propagation of sound is not instantaneous. He will have no difficulty in doing so, even within the limited area of a room. After having thrown a tuning fork into vibration, he carries it with the resonator to different parts of the room and observes the intensity of the sound. He finds that at certain places it becomes more feeble, and concludes from this that there each vibration is annulled by another which took its rise later and arrived at the same end by a shorter route. If, in order to traverse a shorter route, less time is required, the propagation is not instantaneous, and the problem is solved. But then our physicist will show us that the points of silence succeed each other at equal distances; thence he deduces the length of a wave, and, if he knows the duration of the vibrations of the tuning fork, he can now determine the speed of transmission of sound. We operate in exactly the same way with our electric vibrations. The conductor in which the electric variations take place plays the part of the tuning fork. The circuit broken at a given point replaces the resonator, and is actually called electric resonator. We observe that at certain points of the room sparks issue from this latter, that at other points it remains at rest; we find that the inactive points, electrically speaking, follow each other in regular order. From this, we conclude that the propagation is not instantaneous, and can even measure the length of wave. We shall be asked whether the waves we have found are longitudinal or transverse. Let us place our metallic wire in two different positions at the same point of the room; in one position it indicates an electric excitatation, in the other it does not. This settles the question. We have to deal with transverse waves. If we are asked to indicate their speed of transmission all we have to do is to multiply the length of wave which we have just measured by the duration of the vibration which we can calculate. We find a speed very near that of light. If any one should contest the correctness of this calculation, there remains for us another expedient. The speed of propagation of electric waves in metallic wires is enormous, and quite comparable with their speed in the air. Moreover, it has been measured directly a long time ago, for it was easy to study their propagation on wires many kilometres long. We, therefore, possess a purely experimental value of their speed, and, although the result is only approximative, it does not contradict the result we have just obtained.

All these experiments are very simple in themselves, and yet their consequences are most important. They completely upset the theory of an instantaneous transmission of electric forces through space; they mark the triumph of Maxwell's system. This latter is no longer a connecting link between two classes of entirely distinct phenomena. If this theory of light formerly seemed probable, it must now be considered as true. But perhaps, in approaching the end, we might do without the support of the theory. Our experiments were made quite close to that neutral zone which, according to the theory, unites the domain of light and that of electricity. There remains only one step to take to arrive at the proper domain of optics which is so well known to us. This will not be superfluous.

There are many friends of nature who take an interest in the problem of light, who are able to understand simple experiments, and yet for whom Maxwell's theory is absolutely unintelligible. Moreover, direct routes in scientific methods are always preferable to circuitous ones. If, therefore, by means of electric waves we can succeed in producing phenomena similar to those of light, all theorizing becomes unnecessary; the identity of the two classes of facts will be demonstrated to evidence by the experiments themselves. By this way true success is possible.

Let us place the conductor which produces the variation of the electric condition in the focus of a large concave mirror. The electric waves are collected and issue from the mirror in the form of a rectilineal bundle. We can, it is true, neither see nor touch this bundle, but we know that it exists, because we see sparks passing over from it to any conductor it may meet; it becomes perceptible when we arm ourselves with our electric resonator. All these properties are those of a luminous ray.

We can, by turning the mirror, send it in different directions; we can, by studying the path it follows, ascertain that it is propagated in a straight line. If we interpose on its path conducting bodies, they do not allow the electric ray to pass; they carry a shadow, but they do not destroy the ray; they reflect it, and we can follow the reflected bundle, and convince ourselves that it follows the same laws as the reflection of light. We can refract it as well as a luminous ray.

To study the refraction of light we employ a prism; we do the same thing here. Only, the dimensions of the waves and of the ray compel us to take a prism of very large dimensions; we choose, therefore, a very inexpensive substance, pitch or asphalt. Finally, we can study with our ray phenomena which have hitherto been only observed with light, namely, those of polarization.

On the path of the bundle let us place a sort of metallic grating; we shall find our electric resonator emit sparks or remain at rest in obedience to the same geometrical laws which govern the variations of brightness of a luminous ray traversing a polarizing apparatus.

But we have done with experiments; in making them we have arrived in the very midst of the domain of optics. In describing them we no longer speak of electricity, we employ optical terms. We no longer say that currents traverse conductors, that electricities unite; we only see undulations crossing each other in space, separate, combine, strengthen or weaken each other.

Starting from the domain of pure electricity, we have reached step by step purely optical phenomena. The passage has been crossed, the route becomes easy. The identification of light and electricity, suspected by science, foreseen by theory, is definitely established; it has become perceptible to our senses, intelligible to our minds. From the height which we have reached, and where the two classes of phenomena intermingle, our eyes range over the domains of optics and of electricity. They appear to us larger than we imagined. Optics no longer is confined to undulations of the ether of some fractions of a millimetre; it comprises waves whose length is measured by metres, decimetres and kilometres. But, in spite of this enlarged horizon, optics, when seen from this height, is only an appendage of electricity. The latter's gain is still larger. We shall see henceforth electricity in a thousand circumstances where we did not suspect it before; each flame, each luminous atom becomes an electric phenomenon. Even when a body does not give off any light, provided only it radiates heat, it is the source of electric actions. The domain of electricity thus pervades all nature—it pervades ourselves; in fact, is not the eye an electric organ? Such are the results we obtain in questions of detail; those which concern the philosophy of science are not less important.

One of the most arduous problems is that of actions at a distance. Are they real? Of all those which formerly seemed incontestable to us, one only remains—gravitation. Will it likewise slip from our hands? The very laws of its action make me think so. The nature of electricity is one of these great unsolved questions. It may be reduced to the question as to the condition of electric and magnetic forces in space. Behind it rises the most important problem of all—that of the nature and of the properties of the substance which fills space; of the ether, of its structure, its movements, its limits, if any there be. We find this question more and more overawing all the others; it seems that the knowledge of the ether not only ought to reveal to us the condition of the imponderable substance, but also the essence of matter itself, and of its inherent properties, weight and inertia.

The ancient systems of physics asserted that all is formed of water and of fire. Modern physics will soon ask itself if all existing things are not modalities of the ether. This is the *Ultima Thule* of our science; these are the ultimate heights we can hope to reach. Shall we ever reach them? Will it be soon? We cannot tell. But we have climbed higher than ever, and we have acquired a firm footing which will facilitate our ascent and our searching for fresh truths. The road which opens up is not too steep, and the next stage does not appear inaccessible. Moreover, numerous is the crowd of seekers full of ardor and of science, and confidently we greet all the endeavors made in this direction!

TELEGRAPHIC

The Last Click.

IN MEMORIAM—JAMES F. IGOE.

(Dedicated to the night operators of the Associated Press.)

Over the wire the tidings came,
From the far West, of fire and flame,
Where waters from the North come down
By Minnesota's fairest town—
The watchman of the Associate Press,
True to his charge, though in distress,
Called to "the boys," so far away—
His click at first without dismay—
"The *Tribune* palace is on fire;
I sit above the burning pyre."

Again his click came on the wire—
It sounded like a trembling lyre
Of pathos, in the echo near,
That thrilled "the boys" with sudden fear—
"I cannot stay—my comrade's gone—
I'm left upon the floor alone—
Brothers, I go—farewell! farewell!
More news to-night I cannot tell—
Good night! good night!" the silence broke
That click, the last that Igoe spoke.

The parting click, the lingering sound
Through night and space its way had found.
Lest silence seem some proof of blame,
He sent the message through the flame.
The dumb machine on which he played,
The only friend that near him stayed,
Until at last, with 'bated breath,
He sent that plaintive tick of death—
"I can no longer stay"—I go
To meet the rushing, deadly foe.

His click—"I can no longer stay,"
Prophetic words from far away—
It meant—as prophets always mean—
Far more than by themselves is seen.
It seemed to ears that caught the sound,
"The boys" afar who gathered round,
A winged courier in the air,
A note of something like despair,
The death-watch ticking in the room,
To tell of swift, impending doom.

As long ago some martyr stood
Undaunted 'mid the fiery flood—
Brave Igoe stood, true to the last,
Like martyr in the fiery blast—
His hand upon the trembling chord,
To send the parting, faithful word—
Brave watchman! calling at his post,
Though life and home and all were lost,
Ere on the wire himself he swung
Where his last click had sadly rung.

It may be that another wire
Was trembling through the night watch higher—
Some message sweet for him had come,
That told of light and love and home—
"I cannot stay," the parting word,
Some far off call within him stirred.
"Good night! good night!" to friends afar,
The greeting of the morning star—
Till where the broken body lay,
The spirit freed, had gone away.

—J. H. CUTHBERT, in *Mail and Express*.

Washington, D. C., December, 1889

Telephone Methods in California.

It is pretty well known that away out on the Pacific coast the telephone business is very successful. This is attributed by some to the excellent management and intellect of Vice-President and General Manager John I. Sabin, whose company has managed to corral all the telephone business of the Pacific slope that is under the dominion of the stars and stripes; and others to the fact that people in that locality have become fully convinced of the importance and value of this great invention.

Mr. Sabin was a recent visitor in the East, and on his return found the following notice pasted on the transmitters of the company at San Buena Ventura, Cal.:

TO AVOID BEING KILLED READ THIS.

1. Call Central Office by ringing your bell TWICE.

2. As soon as you hear answer by your bell ringing, take down hand telephone and listen. The operator will say, "What number?"

3. Give the number wanted, when you hear the response from operator

4. Hang up your telephone and ring. As soon as you hear the answering ring take down the telephone and talk away.

NEVER ring bell with telephone off from hook. It is a waste of time, no one hears you.

DON'T TALK TOO LOUD.

Upon investigation, Mr. Sabin discovered that up to 6 P. M., Nov. 18th, the manager of said telephone exchange had only, so far, occasion to shoot three men and one small boy, and as this would indicate very successful results from the above notice, Mr. Sabin has about decided that if this accomplished manager succeeds in educating the subscribers before it becomes necessary to exterminate the entire lot, that the least he can do will be to make him a delegate to the next Convention of the National Telephone Association. It is not thought that the Western methods of managing the telephone business will ever become popular in the effete East.

* * It looks now as though the electric road in process of construction at Milwaukee will have cars running by the first of the month.

* * The Media, Pa., electric light plant is about completed, and the streets and stores of Media will be lighted by electricity in a few days.

* * The Fort Scott (Kas.) Electric Light Company is putting in its 125 horse-power engine which is additional to the fine engine already in operation.

* * A bill will be presented to the legislature this winter to create the office of city electrician for Cleveland, Ohio. This was agitated last winter, but it never reached a focus.

* * Mr. C. R. Hosmer, manager of the Canadian Pacific Telegraph, Montreal, Canada, has returned from Halifax. His company is opening a new line of wires from Montreal to Halifax and also from Montreal to Canso, where the commercial cable lands. The lines will be completed about the first of the New Year.

* * There has been recorded at the New Haven, Ct., town clerk's office, by the Empire and Bay State Telegraph Company, a first mortgage bearing six per cent., for $500,000. The mortgage is for the purpose of securing the Farmers' Loan and Trust Company, of New York, who are marketing the bonds of the company. The bonds are being sold for the purpose of building, equipping and operating the lines of telegraph of the company. It is necessary that a public record of the mortgage should be made in each town that the lines pass through.

* * An electrician has just patented something as new as it is unique in the way of a clock. Aside from being a regular timepiece and daily calendar it is also provided with a system of keys making a double circuit around the outside of the clock, the first one to denote the hour and minute, and the other the day of the month. The object is to furnish thereby a regulator for business appointments. For instance, if a man had an appointment at 9.10 o'clock this morning, he would turn the indicator to that time, and as well another to December 1. At the minute exactly this morning an alarm would be turned in, and would continue to ring until stopped. The clock is the first of its kind in America, and has been viewed with considerable interest by the jewelry trade.

Damming for Power.

A company is now being organized at Buchanan, Mich., with a capital stock of $50,000, which purposes to construct a dam in the St. Joseph River, at a point most convenient to that place.

It is claimed that 5,000 horse power can be obtained which will be electrically transmitted to both Buchanan and Niles, Mich.

The project further includes the lighting of the above-named cities, and a long circuit incandescent system which will include the city of South Bend, Ind.

"A Living Magnet."

On the 11th inst. a Baltimore, Md., youth will give an exhibition before the Scientific Association of the Johns Hopkins University of the remarkable magnetic power which he possesses. This power enables him to make objects of considerable weight adhere to his finger tips, contact only being necessary.

Prof. William Simon, of the Maryland College of Pharmacy, has developed whatever strength and remarkable peculiarities the young man displays from the very smallest beginnings.

He has called the attention of a number of Baltimore's medical specialists to the case, and all are at loss to give an adequate explanation.

Electricity in Mining.

In no field has electricity made more rapid strides than in mining. For long transmission of power, economy, reliability, it is far superior to any other method now in the market. In many rich mining locations, fuel is scarce and transportation very high, so that the use of steam power is unprofitable. If water is in the vicinity, intervening mountains or other obstacles are often in the way, and expensive canals, tunnelling or insurmountable grades prevent transmission of power, by the means now practiced, and many mines of great promise have been abandoned for the lack of an economical method of transmitting power, and this has been especially evident in the West and South. By means of electricity, power has been conveyed upwards of 15 miles or more with great saving, and as the power by electricity means an *air line* from point to point, it is very evident that it can be conveyed many miles, where the present means are entirely impracticable. Moreover, the wires can be carried into the mines, and connected with the various appliances used, such as drills, pumps, cars, fans, etc., thus avoiding the necessity of carrying long lines of steam pipe, which are a source of great annoyance and unpleasantness in overheating mines in summer and freezing in winter.

Aside from the ability to utilize cheap or wasted water power long distances away, or to economically transmit steam power from locations where there is cheap fuel, there are many advantages in the use of electrically transmitted power in mining districts, in its ready application to the work in hand. It is easily handled, can be applied at any angle and requires little attention. Electric motors are used in a great many mines of note in this country and those operators are unbounded in their praise, and one company, the Sprague, is now making a specialty of this work. To show the immense amount of saving, the usual amount of power transmitted by the various methods now in use, where the distance is over 1,000 feet, is about 35 per cent. to 40, while there has been upwards of 73 per cent. of the generated power of the steam and water plant transmitted by electricity. Apparatus of all kinds are being manufactured, combined with the electric motor, such as drills, pumps, hoisting machines, etc., making a neat and compact appliance for any and all purposes The installation of such plants costs less than other methods, and the great advantages of the electric system will, beyond a doubt, cause it to supersede many of the plants now used in our larger mines. Where lighting plants are already installed, it is a very simple matter to place motors, thus utilizing any extra power which may be developed. In mines where no electric plant is used, the great advantages of combining light and power can be seen at a glance, and will no doubt be rapidly embraced by the smaller operators. The system is simple and practical. It is economical to build, operate and maintain. It is above mud and floods; can cross streams, canons, or marshes, and the cables are not affected by rain, snow or ice. Its perfect adaptation to mining work is such that its use in many localities would cause a large reduction in working expenses, and often make the difference between success and the want of it. It will pay operators of mines to investigate the electric system thoroughly.

Temporary Currents in Iron.

Professor Trouton's recent paper before the London Electrical Engineers, on "Temporary Thermo-Currents in Iron," refers to currents arising in iron, and also nickel, in consequence of unequal temperature of different parts. If an iron wire is heated in one place only, no currents are observed; if the flame is moved, weak currents of less than 10 millivolts appear as the two sides left and right of the heated place are no longer equal, but represent a thermo-junction. To make these currents more visible, Mr. Trouton coiled the wire to a circle of about one foot in diameter, and moved a number of Bunsen burners under the wire; the current is reversed on changing the direction of the motion and the effect decreases to a constant if repeated frequently. Mr. Newall believed that the temperature must be raised above the critical point, which Mr. Shaw doubted. If raised to the critical temperature a steel wire brightens more and more, then it remains unaltered or becomes darker and brightens again; when the flame is moved there is darkening in front and recalescence behind the flame. Sir William Thomson thought that there may be such currents irrespective of the critical temperature, although he had been unable to observe them in 1850.

Electrical Railways.

BY C. J. KINTNER, C. E.

To the Editor of Electrical Review.

It is less than a decade since the proposition to propel cars and other vehicles by electricity first received serious consideration, and the rapidity with which capital is now interesting itself in this important commercial line of invention should give anyone occasion to halt before accepting, as conclusive, the many advantages claimed for almost equally as many systems of electrical propulsion now in vogue.

The electrical propulsion of land vehicles, or conveyances, may properly be divided into two generic heads, as follows:

1st. Vehicles or cars, propelled by electrical motors, receiving their current energy from a central station, through the agency of current mains connected with one or more dynamo machines in such station.

2d. Vehicles, propelled by electrical motors, receiving their current energy from storage batteries carried by the vehicles themselves, or by dummy engines, or motors attached thereto.

The former class may again be divided into two distinct species, the first of which embraces all forms in which the current is received through the motor located on the vehicle, through contacting devices, having sliding or bearing contact with underground mains; while the second includes all those forms having similar connection with overhead conductors.

This latter form, owing to the unsightly presence of the conductors, together with their dangerous proximity to foot passengers, is undoubtedly out of the question in thickly settled communities; while the underground system is open to the objection of enormous leakage, and hence, often to a stoppage of the entire transit during the time search is being made for the leak or short circuit.

There is no question but that the next decade will entirely annihilate these two forms of electric propulsion in large cities, for the reasons above indicated, and that the storage battery systems will ultimately prevail everywhere

None of the objectionable features are found in the storage battery system, the greatest objection to this form of locomotion being the enormous weight of batteries required to drive the vehicle. There can be no question but that efficient storage batteries are now a matter of fact, and that, from past experience, they can be economically and commercially used for the purpose of car propulsion.

This being assumed as true, the question then resolves itself as to the proper form of applying this source of energy most economically and efficiently.

When the batteries are carried by the car there is an additional objection in the fact, that one cannot control the traveling public so as to give an equal distribution of weight throughout the car, and it is often noticeable that a very large proportion of the weight will be found on either the front or rear platform, as best suits the convenience of this independent class of humanity.

Under this condition of affairs the motor carried by the car is submitted to unnatural strains, and an unequal distribution of the traction upon the several wheels results. In consequence, the motor gearing soon needs repair. Such unequal distribution of load also causes the car to run very unsteadily, and to hammer, or pound the track, thereby greatly increasing wear and tear.

These are features which the average electrician, in the application of electrical power to railway propulsion, appears to have overlooked, and anyone who has traveled over the Fourth avenue route in this city, upon the Julien cars, must have noted the unsteady running of the motor, and the unnatural pounding of the wheels upon the track. Time alone makes this element of wear and tear a very important factor in the expense account.

It does not appear as though electrical engineers had, up to the present time, exercised in the application of storage batteries to railway propulsion, that judgment which civil engineers have to use in the economical distribution of stresses and strains of loaded vehicles upon ordinary railways.

It would appear, at first sight, as though the objections which are above noted, concerning the locating of the batteries upon the car, would be obvious to anyone versed in the manipulation of loaded vehicles, wherein there is a liability of momentary shifting of the load. There are systems, however, which, as yet, appear not to have gone into public use, wherein this very question has been very carefully studied by competent engineers, and the means required to avert the difficulties have been supplied. These systems will yet prevail, because they are based upon common sense engineering principles.

The solution of the problem of electrical propulsion will, without doubt, result in the adoption of independent dummy motors, which carry the storage batteries and electric motors, the passenger vehicles being connected thereto as ordinary passenger cars are connected to locomotives on steam railways.

When it is understood that with the dummy motor or engine properly constructed, so that the four wheels thereof shall bear a fixed relation to the shortest curves in the track over which it is called upon to pass, and that the propelling electrical motor shall be firmly secured to the framework thereof, with the storage battery equally distributed over the four wheels, then, and not till then, will the problem be completely solved.

The advantages of such an arrangement are so apparent that they need but be mentioned to satisfy the most skeptical mind.

In the first place, the load carried by the dummy motor need never exceed that of a car carrying an average load, and hence, the ordinary flat rail will always suffice;

Secondly, the load being equally distributed over the several driving wheels, the best possible traction is had at all times, and with the least possible wear and tear to both the track and the motor;

Thirdly, the traction load is always evenly distributed, no matter what may be the condition of the load upon the drawn cars; a very important matter, as every civil engineer will appreciate;

Fourthly, such a motor adapts itself at once to known forms of horse cars, and is capable of drawing one, two or more, according to the demands of the traffic;

Fifthly, when a motor is run into the central station for a new installment of batteries, or for repairs, the traffic car can be taken by an additional motor;

Sixthly, the motors one, two, or more, may be utilized with snow ploughs, or for drawing freight cars, or for any other purpose, leaving the cars to be utilized solely for passenger traffic; and in proportion to the demand of the traffic, thus limiting the wear and tear of rolling stock to the absolute demand of the travel.

The prophecy is here made, that within the next 10 years the contact systems of electrical railways will go out of use in thickly settled cities, for the reasons above named, and that a majority of street railways in such places will be operated by dummy motor cars, carrying storage batteries and motors, with electrical connections for controlling the same, either on board the motor or on one of the drawn cars.

Railway companies, before accepting figures given by the promoters of the various systems of electric propulsion, should weigh well the evidence, and should learn that merely because an inventor economizes upon horse-power traffic for a limited time, as made evident by an actual showing of figures, it is not necessarily true that in the long run the fact would ensue. They should compare well the outputs, compare the percentages of gains and losses, and only by a long continued series of such comparisons base a conclusive sanction upon such representations.

"Rome was not built in a day," and while there is no doubt but that electric propulsion has come to stay, there is a grave doubt generally as to favorable electrical efficiences as compared with horse and cable car propulsion, when we reckon from the coal to the cash box.

Some Interesting Figures.

The Safety Electric Light and Power Company, of New York, has issued a circular relative to changing its name to the United Electric Light and Power Company. The circular says: "By the exercise of an option which was in force at the time of the issuance of that circular, the company has acquired the control, on very favorable terms, of $550,000 out of the $1,000,000 of the capital stock of the Brush Electric Illuminating Company, New York City.

"We will, by the holidays, be supplying from our stations almost 4,000 arc lights and more than 25,000 incandescent lights, yielding an income of between $900,000 and $1,000,000. The demand for light and power has been greater than we have been able to supply, and, to meet the present requirements of our business, additional machinery for 20,000 incandescent lights is now being installed. Our station buildings have a capacity for 6,000 arc lights and 100,000 incandescent lights."

New Arc Machine of the Westinghouse Company.

Owing to the fact that the arc light is rapidly becoming the recognized method of street lighting in the cities and towns throughout the entire country, it is natural that a great many electricians have devoted their attention to an improvement of the arc light system. The great aim in the development of the arc light system has been to improve the dynamo and make it capable of producing a larger amount of generative power than it has done heretofore.

The Westinghouse Electric Company, after a number of experiments, has at last been successful, and the arc light machine represented in this cut has been the result.

The new arc light machine is the development of the Waterhouse dynamo, which is recognized as one of the best known to-day. For ability, durability and general serviceability the new machine ranks with the best. It is distinguished for extreme simplicity and substantiality of construction.

It is a direct-current dynamo made to run 50 lamps, but in an emergency it will be found capable of running as high as 75 lamps. Any standard arc lamp can be used in connection with this machine. The characteristic peculiarity of the dynamo lies, of course, in its construction, in which the Gramme-ring type of armature is utilized. It is made perfectly self-regulating and will run equally well on one lamp or more to the maximum capacity.

This new machine is especially suitable of course for central stations supplying a large area.

Prof. Henry Rowland at the Electric Light Convention.

The presence of this distinguished scientist at the Kansas City Convention of the National Electric Light Association will be hailed with pleasure by all, and the method of receiving the full benefit of his keen intellect and wide information, as outlined below, strikes us as a very good one. Prof. Rowland is a scientist among scientists, thoroughly independent and unprejudiced. We think his last public appearance in electrical circles was at the opening of the Electric Club, New York, when he delivered a masterly essay on "Faraday and His Discoveries," and gave electrical people more information about Faraday and his great works than had ever yet appeared.

The circular sent out by the National Electric Light Association to its members is as follows:

"Prof. Henry A. Rowland, of the Johns Hopkins University, has, in the interest of science, consented to attend the next Convention of the National Electric Light Association, to be held at Kansas City, February 11–14, 1890.

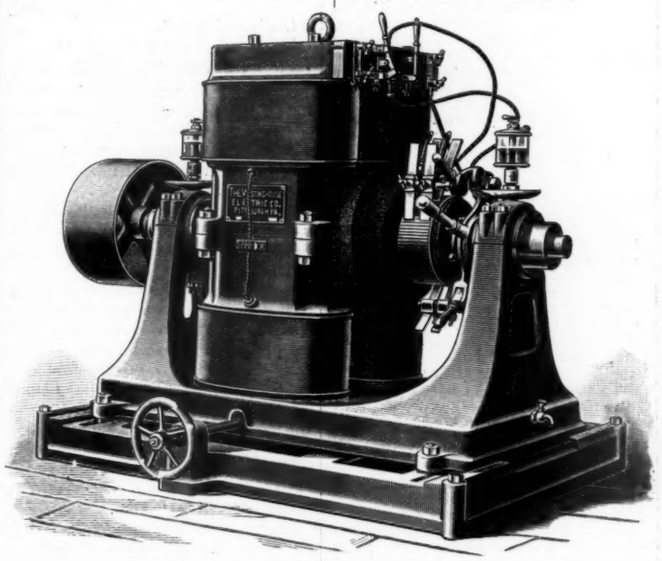
"In order that the visit of this distinguished scientist shall be of the greatest service to the members of the Association, you are requested to address a letter to me stating in as short form as possible the most difficult electrical problem or problems which you meet with in your investigations or the conduct of your electrical business. It would also be well to state what feature of your business is the least economical or efficient, and why; also where the greatest economy could be effected if the difficulty could be overcome. The answers to this letter will be digested and the digest submitted to Prof. Rowland as the basis upon which to found his remarks before the Convention.

"If the members will answer this letter promptly, we feel sure that Prof. Rowland's suggestions for overcoming the difficulties which present themselves to practical men, will be of incalculable value. Respectfully,

"ALLAN V. GARRATT, *Sec. and Treas.*.
"18 Cortlandt Street, New York."

Water Color Paintings not in Danger from the Electric Light.

Our readers will remember that we recently published an article by a correspondent of a paper in England, who wrote to caution those possessing valuable water-color paintings against placing the electric lamps in close proximity to their pictures, as he believed that the new illuminant was sufficiently powerful to cause some of the more delicate pigments to fade to a greater or less degree. He considered that water colors that are safe in diffused daylight are not so when exposed night after night for many hours to the active white light of electricity close at hand. From the public discussion which followed this statement was evolved the fact that when daylight and an incandescent lamp of equal intensity, as measured by the shadow test, are compared for active power, daylight is far more powerful. To set this point at rest two sheets of sensitive (chloride of silver) paper for photographic prints were exposed, one to weak diffused daylight on a wall, and the other immediately under an incandescent lamp (16-candle) with an opal reflector on the top of it. The lamp was adjusted to give about the same depth of shadow as the daylight. The half of each paper was protected from the light for comparison. After four hours the one exposed to weak daylight was considerably colored on the exposed half, and the other paper under the electric light showed absolutely no difference between the exposed and protected parts. The idea, therefore, that the light from an incandescent lamp is more dangerous than diffused daylight to water-color paintings can hardly be supported; it is certainly less active to photographic paper. Chloride of silver paper can be toned and finished under a bright light from an incandescent lamp, without being in the slightest degree affected by it.



IMPROVED ARC MOTOR OF THE WESTINGHOUSE COMPANY.

—— The enterprise of the Chicago, Milwaukee & St. Paul Railroad Company in introducing the electric light on its trains, calls attention to the fact that more progress has been made in Europe in this direction than in the United States. The Midland Railroad, in England, and several French and Swiss lines, are successfully operating electric lights on their cars. Three systems are in operation in Europe: the storage battery, the dynamo run by belting and gearing from the car axle, and the dynamo run by an engine carried either in the baggage car or in a special car. When railway cars are heated by steam, and the electric light has supplanted the oil lamp, traveling in winter will be divested of one great danger—that of being roasted in a splintered car in the event of an accident. The car lamp is a source of danger all the year round, but as cremations on the rail have generally occurred in the winter, the danger of the car lamp is generally associated with that of the car stove. In the East the car stove is becoming obsolete. The change in obedience to law has not been brought about as rapidly as some impatient reformers have desired, but as fast as the railways have become convinced of the feasibility of a system of steam heating, steam has been introduced. Railroad companies everywhere recognize the fact that they will have to progress according to the demands of the people in the matter of heating and lighting their cars.

—— The Brush Electric Light and Power Company, of Savannah, Ga., T. P. Keck, superintendent, in addition to a five-year contract which they have with the city and which does not expire until January 1st, 1891, they have been awarded another four-year contract for 200 1,200 candle power lights at $20,000 per year. This later contract goes into effect January 1st, 1891.

—— The McKeesport, Pa., Light Company has elected the following board of directors: Dr. T. L. White, Henry Reiber and Thos. Reynolds for McKeesport, and J. H. McClements and the manager of the Edison light plants in this State for the Edison interests. The directors organized and elected Dr. T. L. White, president; L. G. Reiber, secretary, and John K. Skelly, treasurer. All of the operators were re-elected.

—— Mr. Edward D. Blackwell, for the past nine years cashier of the Montpelier, Vt., National Bank, has tendered his resignation, to take effect Dec. 31, and accepted a position with the Thomson-Houston Electric Company. Mr. Blackwell has been actively identified with several Montpelier business enterprises during his connection with the bank, of which Hon. James R. Langdon is president, and as officer of the Standard Light and Power Company, of Montpelier, has had business relations with the Thomson-Houston Company.

—— W. C. Clark, San Francisco agent of the Westinghouse Incandescent Electric Light Company, was recently paid $27,000 by the Hip Tuck Jen Company, of 713 Commercial street, upon a $65,000 plant now *en route* from the east to China for the Canton Electric Light Company. The plant is as complete as any in America, and includes a 260 horse-power engine and 2,600 lights. J. F. Donahue, superintendent of the Chinese Company, says that he will take with him 10 skilled mechanics upon a three years' contract to operate the plant.

—— Among the recent orders of the Mather Electric Company, of Manchester, are the following: P. A. Marquam, Portland, Oregon, 800 lights; Jones Brothers Electric Company, Cincinnati, O., 1,000 lights; Endicott Building, St. Paul, Minn., 2,150 lights; Howland's Mills, New Bedford, Mass., 650; Evelyn Flats, New York, 500; Soldiers' Home, Grand Rapids, Mich., 600; Nashua Card and Glazed Paper Company, Nashua, N. H., 400; Border City Mills, Fall River, Mass., 600; James Bancroft & Sons' Company, Rockford, Del., 800; Keasbie & Mattison, Ambler, Penn., 400; Knowles Loom Works, Worcester, Mass., 400; Coolidge Building, Boston, Mass., 400. Besides these, the factory has received orders for about 50 plants varying in size from 25 up to 400 lights. The business this year will show a handsome increase over that of last year.

ELECTRIC LIGHT NEWS

—— The Thomson-Houston Electric Company, of Atlanta, Ga., will erect an electric light plant at Griffin.

—— New England capitalists it is said will invest $200,000 in an electric plant to run the mines at Joplin, Mo.

—— Dowagiac, Mich., has awarded the contract for lighting the city by electricity to the Westinghouse Company.

—— The Cynthiana, Ky., Electric Light and Power Company has let contract for an electric light plant to the Thomson-Houston Electric Company, of Boston, Mass.

—— The Thomson-Houston system of electric light is now being introduced into Charles City, Iowa, and is expected to be in operation in the course of a couple of weeks.

—— The Crawfordsville, Ind., electric light and gas works have been bought by a New York syndicate for $105,000. The same combination owns the water works at that place.

—— The work of putting up the electric light at Jeffersonville, Ky., has commenced. Chief Electrician Hackett, of Cincinnati, is in the city, and he promises to have the plant complete and the city lighted with electricity by Christmas time.

—— Mr. Patrick Fahey, superintendent of the Boston Electric Light Company, states that his company had five circuits burnt out, and that he estimates the company's loss from the recent fire, at between $2,000 and $3,000 on wires and fixtures.

—— Superintendent Miller, of the Bloomington (Ill.) Thomson-Houston Electric Light Company, has just placed in position a new alternating dynamo, with 500 light capacity. This new dynamo has been added to the plant to meet the increased demand for light.

—— Crookston, Minn., and Dowagiac, Mich., are about to establish an incandescent light plant for 750 lights each. The contracts for furnishing the central station apparatus for alternating current system were awarded to the Westinghouse Electric Company.

—— To judge by appearances, the electric light system in the Jamestown (N. Y.) Worsted Mills is all that was expected or desired of it. Two Edison dynamos have a capacity of 1,100 incandescent lamps, of which about 900 are now in use in the big mills. The Edison Company has spared no pains to make the plant as perfect as possible.

—— During the past week the following sales of the Wood arc apparatus has been made by the New York office of the Fort Wayne Electric Company: Manhattan Electric Light Co., Manhattan, Kansas, 25 lights; Oswego Electric Light and Power Company, Oswego, N. Y., 240 lights; Vancouver Electric Railway Co., Vancouver, B. C., 180 lights.

—— A report by M. Hippolyte Fontaine states that the first practical and permanent electric light installations were made in several French workshops in the winter of 1874–75. In 1878 the electric candle and the regulators in series introduced the employment of the voltaic arc into shops and public streets, and in 1880 the incandescent lamp gave electric lighting the entree into private houses. The latest documents at hand show that a motive power of nearly 1,000,000 horse-power is now converted into electric light, corresponding to a total intensity of about 200,000,000 normal candles; that the number of central stations exceeds 1,500 and that of private installations 10,000, and that the capital sunk in electric lighting amounts to more than 1,000,000,000 francs. The United States has more electric lights than all the rest of the world.

OUR LONDON LETTER.

PROGRESS IN ELECTRICAL INVENTION—IMMENSE DYNAMOS—STATUE TO OHM—THE GILBERT CLUB, ETC.

Ours is a great power, human beings of to-day, mighty inheritors of knowledge stored up through ages, the magnitude of the labors of centuries to contemplate and proud possessors of that first great goal in the carrying out of any work, the knowing on what point to begin, and from the failures of our predecessors what it is we must avoid. Heirs of the past the ground is ready, it is for us to sow good seed, and though we may never reap, still to pass forward to our descendants the task, furthered a good stage, which we received from those who preceded us, how to better the social as well as the moral condition of our fellowmen. Every day sees some advance, there must be a continual progress in all arts and in every science, stagnation is an impossibility. I am no *laudatori temporis acti*. I am no believer in the wild hopes of visionary dreamers that the golden age is near, or so long as this world and its human nature exists, even possible; but neither can I altogether agree with the gloomy doubts of one who is in much a philosopher that it is a matter of great doubt "whether all the machines and inventions of mankind have ever yet lightened the day's labor of any one human being.

In no science has such progress been made of late years in this country as in electricity, and it is a matter of wonder to notice the varied uses to which this mighty power is now being put. At the gold fields by an electrical treatment of the ore the gold is being separated from the tailings, and by one system (Cousin's) 90 per cent. of the gold has been obtained. For medical purposes by the application of high tension currents, five cases of cancer have recently been cured, the patients having previously been operated upon by the surgeons and given up as hopeless. Sewerage is now being electrically deposited at Cross Ness, and metals are being treated by the Elmore process, which was introduced by Messrs. Woodhouse & Rawson, Limited, for making copper articles and which has proved in every way successful; a similar process for zinc is about being introduced and for which a like result is expected.

The first ordinary general meeting of the Woodhouse & Rawson United Company, Limited, was held last week and the chairman, Sir Rawson W. Rawson, was able to speak in the most hopeful way of the prospects of the company. There has been a further issue of ordinary and preference shares and the debentures of the company, the former at a 5s. premium and the debentures at £2 premium. The shares of other electric companies having risen so greatly since last July, the field covered by this company being so large and the directorhood being a powerful one, it is not surprising that the issue was rapidly taken up.

From the 1st January next the galleries of the British Museum will be open from 10 A. M. to 10 P. M., the electric lighting being now ready, new machinery having been put in and tested.

Messrs. Laing, Wharton & Down, who are the representatives of the Thomson-Houston Electric Railway Company, have issued a very concise and clear pamphlet showing their system. The main conductor is overhead and three methods are employed for supporting. Mr. W. S. Graff Baker has come over to England to personally superintend the "energetic introduction," and the splendid testimonials received from American companies should help him in his endeavors to show the interested people of this country the many advantages of electric traction.

The new works of the Electric Construction Corporation, Ld. (late Elwell-Parker, Ld.), at Bushbury, near Wolverhampton, have been commenced and are expected to be ready for occupation about June next. The contract which was for £40,000 has been secured by Mr. Henry Lovatt, a local contractor. The works will be of a most extensive character, complete and self-contained in every particular, and there will be a siding to connect with the London and North Western Railway Company.

The Institution of Electrical Engineers have decided to hold a special meeting in Edinburgh before or immediately after the British Association's Congress at Leeds, which will secure the attendance of at least some of the leading members of the Institution at the Edinburgh Exhibition. The misunderstanding which has existed between the electric trade and the Exhibition authorities has now been set right, and the council of the Exhibition has shown its desire to act in a conciliatory and business like manner. While free space cannot be granted to electrical exhibitors, any balance remaining after the satisfaction of all lawful demands will be devoted to their reimbursement; current would be supplied free to any exhibit if required, and the Exhibition would undertake the insurance of exhibits.

Messrs. J. K. Fahie & Son are carrying out an extensive installation at the residence of Mr. Richard Burke, the Master of the Tipperary Hounds, Grove House, in the County of Tipperary. A vertical steam engine, Elwell-Parker dynamo and a set of accumulators to run about 100 lamps, will be used for lighting not only the dwelling house, but the outhouses, stables and kennels, in addition.

About £1,200 having been collected throughout Germany, England, France, Austria, etc., a statue is to be erected to the famous Ohm, at Munich. In the event of a surplus, another memorial will be erected at Erlangen, where he was born more than a century ago.

At Berlin business men are pressing forward the regulation of public clocks by means of electricity, and a large number more have lately been fixed to be controlled by the Berlin Observatory. The clocks are pneumatic, but the apparatus is set in motion by an electric current transmitted through the telephone wires. It is claimed for the system that it is much less expensive and easily applicable.

Four enormous dynamos for the use of the two large central stations in Berlin are now being constructed at the works of Messrs. Siemens & Halske, at Charlottenburg. They are each of 1,000 horse power and capable of feeding 10,000 glow lamps. The machines are composed of a fixed cruciform electro-magnet with rotating ring-shaped armature over three meters in diameter. The London *Standard* states that a contract has been signed between the Commune of Rome and the Anglo-Roman Gas Society for the electric lighting of Rome and its suburbs. Seven hundred and six gas lights are to be replaced by 167 electric lights, the increased expense of which will be nearly 36,000 francs annually.

Following out the idea of an English company, who some years since fitted up the "Great Eastern" as an exhibition of one of the largest of the North-German Lloyd steamers and having three decks, is now being arranged in eight exhibition rooms and displaying samples of the various industries of Germany. There will also be music, dining and smoking rooms, and the vessel will be heated with steam and lighted throughout by electricity. Unlike the "Great Eastern," which was made stationary, the present enterprise will go round the world stopping at 80 different ports.

Through the courtesy of Messrs. Ashurst, Morris & Crisp, of Old Jewey London, who are the solicitors acting for the proposed central London electrical railway, I am able to give you some interesting particulars. Both lighting and working will be done by electricity. One terminus will be at Queen's Road, Bayswater, and there are to be stations near the Marble Arch, the General Post Office and the Royal Exchange; the line finally joining the city and Southwark subway about Arthur street, West. Two iron-bound tunnels are to be built so far beneath the surface that there will be no interference with the sewage arrangements or the water or gas pipes, and even while the work is in progress the traffic on the line of route will not be in the smallest degree hindered. So immense an undertaking is not to be comprehended in a moment, and at the present time public feeling would appear to be in opposition to the scheme. Last Tuesday the subject was brought before the meeting of the City Commissioners of Sewers at the Guildhall, and several members having expressed themselves as being strongly opposed, the matter was finally referred to the Street Committee.

The work of the Chelsea Electricity Supply Company, Limited, having very greatly increased, a further issue of ordinary shares is announced.

At the last meeting of the Institution of Electrical Engineers, a paper was read by Mr. K. L. Murray "On the Lighting of the Melbourne Exhibition."

On November 15th at the Physical Society, Professor Reinold, F.R.S., the president in the chair, Mr. Enright, resumed and concluded the reading of his paper "On the Electrification Due to the Contact of Gases with Liquids." Mr. Herbert Tomlinson, F.R.S., then gave a paper "On the Effect of Repeated Heating and Cooling on the Electrical Resistance and Temperature Co-efficient of Annealed Iron."

An association is about being formed and to be named the "Gilbert Club," with the object of bringing out an English edition of Dr. Gilbert's "De Magnete," and to reproduce the folio edition of nearly three centuries ago. The tercentary of the "Colchester philosopher" is also to be organized in a fitting manner for next year. The club is to be very exclusive, but among those who have consented to become members may be mentioned Sir William Thomson, Sir David Solomons, Lord Rayleigh, Professors Tyndall, Rücker, Forbes and Reinold, and Messrs. W. H. Preece and Latimer Clark. The first meeting is to be held on the 28th inst. at the Society of Arts, and the honorary secretary is Professor Silvanus Thompson.

The employés of the National Telephone Company, Limited, held their annual supper in Glasgow last week, and the chairman, Mr. D. Sinclair, in a short speech gave some interesting particulars in regard to the company's working. The company was formed in Glasgow some 12 years ago and has now in that city 3,134 subscribers, having in the course of last year put on 548 new wires. In Glasgow there were 30 exchanges, the total length of wires being 3,440 miles, last year's increase being 1,000 miles. Through Great Britain the company had 26,632 subscribers, using 32,040 miles of wire, with a daily average for calls of 230,688. In Glasgow the average of calls was 30,341, or for each subscriber 9.86 calls.

The 100 guineas prize which was offered two years ago by our esteemed contemporary *Industries*, has at last been decided to have been won by Messrs. F. S. Anderson and J. O. Girdlestone for their design of the "Agir" motor. In making a decision between the two best designs, it became necessary to build two 10 horse-power motors, and these were tested at the Silvertown Works of the India Rubber, Gutta Percha and Telegraph Works Company, Limited. The prize motor is designed to work with a current of 150 volts, weighs 985 lbs. and is a two-pole series wound machine.

A new electric railway is proposed in Buda-Pesth and it is expected the system favored by the government will be that of M. Zipernowski. The novelty is in the method of switching the cars at junctions, and the distributing leads are arranged under the road in concrete conduits.

The October Board of Trade returns of exports of electrical apparatus, etc., show a very considerable movement during the last month, and from January 1st to October 31st have doubled in value the corresponding exports for last year, and are nearly 25 per cent. more than in 1877.

CHARLES FFRENCH.

London, Nov. 19th.

Electrical Counting Machine Wins.

A commission recently appointed by Mr. Robert P. Porter, superintendent of census, at Washington, for testing the different methods of tabulating census data, has resulted in favor of Mr. Herman Hollerith's electrical method.

There were two other contesting methods, the ones in question being submitted, respectively, by Messrs. William C. Hunt and Charles H. Pidgin.

To test these various methods, four enumeration districts in the city of St. Louis, selected from the re-enumeration in 1880, were chosen. These districts contained 10,491 inhabitants. Each contestant was required (a) to transfer the information from the schedules to cards or chips; (b) to tabulate this information in the form of a table for the purpose of testing the rapidity of the methods, and (c) to tabulate in the form of extended tables for the purpose of testing the capacity of the methods.

The test was begun early in October, and on November 11th Messrs. Hollerith and Hunt having completed the test of their methods, and Mr. Pidgin's test being so far advanced that all desired information could be furnished, it was decided to suspend further work and consider the results.

After due consideration of these results, and in consideration of its superior merits of rapidity and accuracy in tabulating, the commission recommend the Hollerith system. The following shows the difference in the three systems in point of time occupied in transcribing: By punching, Hollerith's method, 72 hours and 27 minutes. On slips, Hunt's method, 144 hours and 25 minutes. On chips, Pidgin's method, 110 hours and 56 minutes.

Time occupied in tabulating for the form of table selected as a test of speed: By the electrical machine, Hollerith's method, 5 hours and 28 minutes. By sorting slips, Hunt's method, 55 hours and 22 minutes. By sorting chips, Pidgin's method, 44 hours and 41 minutes.

A Deep Hole.

The deepest bore hole in the world, claimed at different times for a number of places, is, according to a German contemporary, at Schladebach, a small German village near Leipsic. It measures 1,748.4 metres, or about 5,735 feet. The time expended in boring to this depth amounted to six years, at a cost of $52,500. A peculiar experience encountered in connection with this and other deep holes in different parts of Germany, is that the observed temperatures, while steadily increasing with the depths, show a smaller ratio of increase in the lower strata.

The Comparative Merits of Continuous and Alternating Currents for Central Station Working.

We stated some time ago, says *The Telephone*, that the question of central station lighting in Frankfort-on-the-Main, which had been decided in favor of alternating currents, had, by the municipality, been referred back to a committee appointed for the purpose. The most prominent members of the committee were the well known electrician, Prof. Dr. Kittler, of Darmstadt, and the city architect, Mr. Lindley. The final decision was again given in favor of the alternating current, and the Zipernowsky system of alternating dynamos and transformers will now be adopted. There can be no doubt that the decision was arrived at after an impartial and most exhaustive examination of the bearings of the case, and we have repeatedly expressed our opinion that the employment of alternating currents may recommend itself in many cases from reasons of local conditions and requirements; at the same time we are more than ever convinced that, taking the two systems at their respective merits, the continuous current ought to be used wherever there are no insurmountable obstacles either of expense or of installation. This question is becoming of daily greater importance since the electric light industry has at last in this country, too, shown fresh signs of activity. We cannot do better than acquaint our readers with the opinions on this subject expressed by a German authority, Prof. Rühlmann, in the *Elektrotechnische Zeitschrift*, August, 1889.

There can be no doubt the employment of an alternating current of high potential presents that great advantage that even large towns can be supplied with electrical energy from one single station situated at some distance. The concentration effected by this system permits an economical production of energy by means of large machines; it enables the work to be carried on with a comparatively small staff, and the station to be erected in a favorable locality where coals and water are easily procured, and ashes, cinders, and condensation water can easily be got rid of. And, further, the regulation of E. M. F. presents but little difficulty in a system of alternating machines and transformers; accidential variations of current consumption are more easily balanced in a large installation than in a small one.

On the other hand, it cannot be denied that the farther remote the station is from the place of consumption, the greater the difficulties of working and of administration; further, that in large towns which are divided in two parts by wide rivers, the installation of special stations on either side of the river will be found more advantageous, and also that the inconvenience to the neighborhood arising from the establishment of a central station is not nearly so great as, for instance, the nuisance created by a railway station. In all towns of large or moderate size, provided there is no water-power available, the saving effected by the alternating system in copper conductors will be more than outweighed by the cost of transformers. Even the comparative cheapness of building ground outside a large town need not be taken into serious consideration, because experience has shown that a central station can be installed in the back premises or in the yard of large warehouses or similar buildings. The first and most essential conditions to be fulfilled by a central station are:

SECURITY OF LIFE AND PROPERTY AND RELIABLE WORKING.

Now, there cannot be the least doubt that the employment of high potentials in the mains is not without danger. Unless we are prepared to suffer a large loss of energy in the transformer, we are obliged to use relatively thin insulating layers between the primary and secondary conductor. A perforation of this insulating layer, and a consequent entrance of a dangerous potential into an inhabited dwelling, may therefore take place under certain unfavorable conditions. Of the many safety devices which have been proposed for the prevention of such accidents, none has yet stood the crucial test of practical application. However, a whole series of untoward circumstances must concur to cause a fatal accident, and the drawbacks of the alternating system on that score cannot be considered very serious. A much more serious risk seems to be that of the laborer working underneath the street, and who may, by a blow of the axe, lay bare a portion of a conductor conveying a current of high potential. It is a well-known fact that such work beneath the streets is continually being carried on in large towns, and carried on by men who are totally ignorant of any danger arising from currents of high potential, and the possibility of accidents arising from this source must, therefore, not be lost sight of.

It seems to be universally recognized that economical working of central stations is impossible without

PARALLEL CONNECTION OF MACHINES OF DIFFERENT SIZE.

That this parallel connection of alternating machines of equal size and identical construction is possible, cannot be doubted; and yet it seems as if the difficulties of this connection had not completely disappeared, since Ferranti in his Deptford station does not propose to avail himself of the great advantages of the parallel arrangement. It is also known that the attempt made by Messrs. Ganz & Co., in the presence of Prof. Kittler, to connect in parallel their alternating machines at the Rome central station gave altogether unsatisfactory results. Zipernowsky, the electrical manager of Ganz & Co., in order to facilitate parallel connection, had even reduced the number of alternations to 42 per second. Mordey's experiments, too, are not altogether convincing, because they were made with two entirely identical machines. Also the frequent breakdowns at the small alternating station of Marienbad, in Bohemia, even as recently as the spring of the year, are ascribed, whether justly or not, to the difficulties encountered in the parallel connection of the Ganz alternators.

Although we are convinced that parallel connection of alternators of different size is possible, even for practical purposes, yet it must be stated that until quite recently the difficulties had not been completely overcome, and that no solution of this problem, indispensable as this solution is for central station working, has as yet been published.

LOSS OF ENERGY IN THE TRANSFORMERS.

That this loss is relatively small is well known, as is also the fact that the percentage of these losses increases when the transformers are not fully loaded. At full load the loss of energy is about six to eight per cent. (provided the primary and secondary wires are separated by an insulating layer of sufficient thickness), while this loss is increased to 15 per cent. when the transformer works at one-third of his maximum load only. Now, since all apparatus in a central station, and therefore also transformers, must be arranged in such a manner as to satisfy even a considerable additional consumption, and since the average consumption hardly amounts to 15 per cent. of the possible maximum output, the working during the greatest part of the year will be carried on with a loss of energy compared to which the loss incurred in a continuous current system during the short periods of maximum consumption is but slight.

On the other hand, it must be admitted that the diminution of loss with increasing load in the transformer system makes up to a certain extent for the larger number of motors and dynamos required in this system to produce the same effect as with continuous currents.

A partial switching off of transformers during the time of small consumption may be feasible; whether it can be done in practice without great difficulty, with apparatus working at a potential of 2,000 volts, we have as yet no means to ascertain.

ARC LIGHTING WITH ALTERNATING CURRENT.

It has lately been asserted by interested parties that the arc light obtained with alternating currents is hardly, if at all, inferior to that obtained with continuous currents. The fact, however, that in a continuous current arc lamp the positive carbon is hollowed out in form of a crater, and that in the interior of this crater a larger surface is heated to a higher temperature, will always have this consequence, that continuous current arc lamps radiate the light, not only in a direction particularly favorable for use, but also that for the same amount of expended energy a larger quantity of light is produced by these lamps than by arc lamps driven with alternating currents. Measurements which have lately been made, and whose publication is promised at an early date, show that at equal expenditure of energy an alternating current arc lamp only gives about 66 per cent. of the mean spherical light intensity of a continuous current arc lamp. At an angle of 40° to 50°, a lamp of the latter kind gives three times as much light as an alternating current one expending the same energy.

It is possible, by fixing proper reflectors above the arc lamps and by using two carbons of different diameter, to increase the efficiency of the alternating current lamp, yet it must always be taken into consideration that to obtain the same light effect with this later kind of lamp as with continuous current ones about 30 per cent. more of electrical energy must be expended.

Taking the case of the Berlin stations, where nearly one-half, and of the Elberfeld one, where about one-third of the energy produced is consumed in arc lamps, this inferiority of the alternating current is of very considerable account in calculating the size of the installation and the working expenses, and consequently also in the prices to be charged to the consumer.

ELECTRO-MOTORS.

The present tendency in Germany seems to be that municipal bodies erect their own central stations, and work them not so much for making any profit out of them as for conferring a benefit upon the consumer, and in these schemes the employment of electro-motors is a most important point to be considered.

That synchronous alternating current motors can be worked with equally high efficiency as continous current ones can no longer be doubted. But synchronous motors require special apparatus for starting, because the synchronizing tendency of all alternating machines will only prevail after the number of their alternations has become nearly equal. This must naturally entail a relatively greater complexity of alternating current motors. And further, we must not forget that synchronism of very small electro-motors would lead to a very high speed of rotation quite inadmissible in practice, and also that electro-motors of constant speed are wholly impracticable for a large number of applications (lifts, for instance). But it will be found that it is exactly this possibility of driving *small motors* of different kinds which has to be considered in the first instance. It is a well-known fact that for small industries steam and gas motors of one to six horse-power are the most extensively used. The favorable results which Tesla and Ganz & Co. have lately obtained with alternating current motors of 50 and 30 horse-power cannot be considered as proving that small motors can be driven economically with alternating currents.

TESTING SET AND BATTERY COMBINED.

And again, if we are told that Prof. Kittler has seen a Ganz motor working at Buda-Pesth, and has convinced himself by his own measurements that at full load 78 per cent., and at half load 74 per cent. of the electrical energy expended were converted into mechanical energy, we must not forget that a good continuous current motor under similar conditions would have shown an efficiency of about 90 per cent.

In many applications it would also prove a serious drawback that synchronous alternating motors when over driven, be it for a short time only, stop altogether and have to be started afresh.

It is a very significant fact that the internal arrangement of alternating motors has hitherto been kept a profound secret, although patent legislation in all civilized countries sufficiently protects the inventor; this points to the conclusion that it is not considered desirable to expose the apparatus in its present imperfect condition to scientific criticism.

In short, even admitting as correct all that has been stated by uninterested and competent authorities in favor of the alternating motor, it cannot be denied that the alternating motor is vastly inferior to the continuous motor both in efficiency and in general adaptability, and that small motors of the former kind do not yet exist in practice at all.

It is quite a different thing to work out a new mode of application of electricity on paper, and to apply it economically for industrial purposes; a long gap lies between the two which generally requires a good deal of time and money in filling up.

The working of electric tramways with alternating currents, which has been proposed by the Westinghouse Company, has not, to our knowledge, met with any practical result as yet. We have at present not even the means of judging of the possibility of such an installation.

CHEMICAL EFFECTS OF ALTERNATING CURRENTS.

It is a well-known fact that chemical effect cannot be practically obtained with alternating currents. We, however, do not attach so much importance to this drawback as is done by many other electricians. The employment of accumulators in central stations undoubtedly presents many advantages, but is not, according to Mr. Rühlmann, of paramount importance yet. In districts where there is a constant supply of electrical energy, the want of accumulators will not make itself felt to any large degree; only in special cases the impossibility of charging accumulators from a central station will appear as a distinct drawback of the alternating system. Especially for theatres and similar localities where large numbers congregate, the employment of accumulators for lighting in case of accidents, ought sooner or later to be made compulsory by law, and it is therefore only natural that in a town possessing a central station the accumulators should be charged from the leads of the network. Further, for tramways to distant suburbs accumulators will probably find extensive employment, and it is desirable to connect the charging stations with the central station.

When in Doubt, Call it "Electricity."

The Boston fire is rather vaguely charged to electricity. Pretty much everything that is not understood is charged to electricity, just as everything from a headache to an earthquake used to be charged to the gulf stream. It is probable that some of these strange disappearances are due to electricity. A Janesville man whose disappearance is still a mystery was last seen in his back yard stroking a cat. What is more likely than that the electricity set free in the cat's fur reduced the unfortunate man to ashes?—*Milwaukee Sentinel.*

The Lungren Lamp.

TO THE EDITOR OF ELECTRICAL REVIEW:

We enclose clipping from the *Philadelphia Record*, which originated in your paper, and believing that you have no desire to create a false impression regarding the work which we are doing for the Government, will say that the heat generated by the Lungren lamp when placed in a combination fixture for use with the incandescent light, does *not* destroy the insulation of the fixture wires. The matter has been tested by the direction of the Treasury Department, to determine this point, and the result conclusively establishes the fact that the insulation is not injuriously affected. We have a copy of the official report to that effect. The test was made by Mr. J. E. Powell, electrician of the Treasury Department, to whom we refer you for confirmation of this statement.

THE SIEMENS-LUNGREN CO.,
Phila., Dec. 5th. E. STEIN, *Prest.*

New Wheatstone Bridge Testing Set, With Battery Combined.

This is a very convenient and portable instrument, combining in one case a rheostat, bridge, galvanometer, double contact key and five cells of the latest and most improved form of chloride of silver dry battery, which will supply sufficient current for all ordinary conductivity tests up to one megohm. The galvanometer needle is of peculiar construction and very sensitive, and will continue so for many years under all ordinary circumstances. The pointer is of aluminum and of a sufficient length to show a clear reading with the least movement of the needle.

The galvanometer is so arranged that the apparatus may be placed in any position without regard to the points of the compass, as the galvanometer is so constructed that it can be readily revolved either to the right or left to obtain a zero point without in any manner interfering with the connections. The bridge contains three coils on each side of respectively 10, 100 and 1,000 ohms. In the rheostat the resistance coils are arranged in four rows of 10 coils each, the rows being units, tens, hundreds and thousands, thus giving an extreme range of measurement from $\frac{1}{10}$ to 1,111,000 ohms. These instruments are all carefully adjusted in a thoroughly equipped electrical laboratory, far removed from all governable influences likely to create electrical disturbance, and are therefore very accurate.

The chloride of silver batteries are entirely separate from the testing set and are provided with flexible selecting cords whereby from one to the entire number of cells can be instantly connected to or disconnected from the instrument. This admits of the use of any battery which may be convenient when testing in the workshop or laboratory, thus reserving the chloride of silver cells for occasions where a portable battery is actually required. The chloride of silver battery, however, being a proper testing battery and doing the best kind of work, many will prefer to use it at all times; therefore the battery is so arranged that it can be conveniently removed from the case for shipment to factory for renewal when exhausted. The whole outfit is contained in a polished mahogany case, and weighs but 12½ pounds, and is manufactured by the E. S. Greeley & Co., New York.

Conduits for Interior Electrical Work.

The new conduits manufactured by the interior Electrical Conduit Company, N. Y. City, insure absolute immunity from fire from concealed electric light wires, state the manufacturers, and have been thoroughly tested in a number of buildings. These conduits are suitable for any system of electric lighting, high or low tension, and have been devised for the purpose of reducing the cost of wiring buildings, and at the same time eliminate all dangers from fire from the electric current, as well as to add to the reliability of conductors. The system in brief consists of a highly insulating and waterproof tube in connection with junction boxes and outlets, designed to meet any requirements that may occur in practice. The tubes are made in sizes from one-quarter of an inch to an inch and a half, inside diameter, in lengths of 10 feet, and are joined by a sleeve which prevents moisture from entering at the joints. The factory of the company on West 27th street, this city, is turning out large quantities of the tubing, and among the recent work done by the company is the following: The new building on 38th street of the Metropolitan Telephone Co., has been wired and conduited for some 600 lights; the residence of J. Pierrepont Morgan, N. Y. City, 800 lights; the residence of Prof. Elihu Thomson, Lynn, Mass.; the new apartment house (the "Shoreham") of Vice-President Morton, Washington, D. C., has been wired and conduited for 2,500 lights; Lincoln Bank building, N. Y. City; the residence and out-buildings of William Rockefeller, of Tarrytown; F. R. Upton's residence in Orange, N. J.; the Union Trust Co., for the U. S. Electric Light Co., N. Y. City; in Boston, the Shoe & Leather Exchange building, for the Mather Electric Light Co. Besides these, a large number of the new fine buildings of the country have adopted this system through the architects. The new building of the daily *World* is one of them.

An electrical club will be formed in Milwaukee. All those engaged in electrical service in connection with telephone, telegraph, illuminating and railroad companies, are eligible to membership. One of the objects of the club is to arrange for a course of lectures on electrical subjects, to take place during the winter.

KINDRED INTERESTS

The Tucker Electrical Construction Company.—This company is doing a very large business in local construction work, and may be credited with fitting out a number of the newest buildings in this city. They are making a specialty of work for electric light companies, and the work pleases all customers.

The Ball Electric Company.—This company has recently sent out from its general offices, at 18 Cortlandt street, a catalogue with a silver embossed front cover that is at once attractive and pleasing. The Ball people are doing a large business, and, although under conservative management, is compelled to keep a large force of skilled workmen at work all the time.

Hazazer & Stanley.—New machinery is being added to the busy factory of this firm, 34 Frankfort street, New York. No electrical house in the city enjoys a better reputation for good work, and none is more crowded with business. The west end of the large factory building has recently been ornamented with a sign of such force and conspicuousness that every passer-by is compelled to stop and read.

John Stephenson Company.—This widely-known car manufacturing company, as a natural result of its entering the electrical field early and of its taking pains in adapting its cars to the various and constant improvements going on in the electrical railway work, has secured a large and rapidly increasing patronage, and is to-day turning out a great many street cars for electric railways. The large factory in this city is very busy at the present time.

The Arc Light Business of the Westinghouse Electric Company has obtained an extraordinary impetus lately. From month to month the sale of arc light apparatus has increased until, during the month of November, machinery for a total capacity of 1,290 lights was contracted for from the following places: San Francisco, Cal., 1,000 arc lights; Du Bois, 35; Cedar Rapids, 70; Seymour, Ind., 70; South Berwick, Me., 10; Bridgewater, Mass., 35; Sprague, Wash., 35; Bloomington, Ills., 35.

The Phœnix Glass Company.—In no department of electric work is there more room for artistic and interesting designing than in the manufacture of globes and shades for electric lamps. The Phœnix Glass Company is one of the pioneers in this field, and is to-day doing a very extensive business with a very superior line of arc and incandescent globes, opal, etched and roughed. The success of the Phœnix Company in this field is well deserved and is a tribute to the foresight of the wide-awake manager, Mr. A. H. Patterson, of New York.

The "Locomotive Engineer."—Among the newer successes in periodicals is to be classed the *Locomotive Engineer*, devoted to the special interest of locomotive engineers and firemen, and to locomotive maintenance and repairs. It is a handsomely printed journal (illustrated), and contains a great deal of very valuable practical information. Mr. Horace B. Miller is president and business manager, and Mr. John A. Hill editor, and these gentlemen are to be congratulated on the success which has greeted the *Locomotive Engineer*. It is now entering its third volume.

Sawyer-Man Electric Company.—It is not often that a manufacturing company is compelled to notify its customers that it cannot fill its orders. The letter published by General Manager Alexander would indicate that the incandescent lamps of the Sawyer-Man Company are being appreciated beyond expectation. The incandescent business has made wonderful strides during the past 12 months, and the great demand for lamps has even exceeded the immense facilities now owned by the Sawyer-Man Company, and additional factory accommodations have been arranged for, and customers will then be supplied more promptly. At present, orders for weeks ahead are being booked.

The Electrical Supply Company, Chicago.—This company has just brought out the arc globe protector as a feature of arc lighting of value to every electric lighting company in the country. It overcomes all the annoyances caused by the accumulation of dirt on the bottom of the globe, and dropping of heated carbon and melted copper from the carbons, which blackens the glass and which is also liable to crack. The protector consists of a transparent mica disk, strongly bound with copper, and is intended to be placed on the inside of the globe with the carbon passing through an aperture in the center. A principal advantage is in the economy in the saving in breakage of globes.

The Eastern Electric Cable Company of Boston.—The semi-annual dividend on the preferred stock of the Eastern Electric Cable Company of $1.50 per share at rate of 6 per cent. per annum was declared to stockholders of record December 10, payable December 16. There is $180,000 of this 6 per cent. preferred stock, says the Boston *News Bureau*. The business of this company has steadily increased, and it begins this week to run its factory day and night. It has made improvements on the present plant that will increase the output about 50 per cent. A late single mail brought orders for 54,500 feet, or 10 miles, of this company's insulated wire. The business of the company for 11 months shows an increase of 50 per cent. over corresponding months of last year, and the last 4 months an increase of over 100 per cent.

The Central Railway, Peoria, Ill.

The energy and push which characterize our western cities is shown in no better way than the rapid introduction of the electric railway. Realizing the great benefits and advantages to be derived from electricity as a motive power, they have been quick to avail themselves of it.

The electric railway at Peoria, which is shown in the accompanying illustration, has been in operation since September 28th, 1889, and, as expressed by a local paper, "without losing a single trip from any electrical trouble."

The electrical equipment was done by the Thomson-Houston Electric Company, the overhead cross suspension method being used throughout. The road is 10 miles in length, and has 15 motor cars, each equipped with two 15 horse-power Thomson-Houston motors. The steam plant consists of three 60"x18' boilers, and one 250 horse-power Reynolds-Corliss engine, which is belted to a countershaft, to which are belted two 80 horse-power Thomson-Houston railway generators.

The cars used in Peoria are somewhat different from those ordinarily employed, as will be seen from the illustration. A closed compartment containing the controller stand and brake handle is provided at each end of the car, thus protecting the motor man in stormy weather, and separating him from the passengers, and consequent interference in operating the car.

When this line was first put in operation it was compelled to take care of an unusually large traffic on account of the county fair, which was done to the satisfaction of the public and the officers of the road.

VIEW OF THE ELECTRIC RAILWAY AT PEORIA, ILL.

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON DECEMBER 3, 1889.

416,169 Regulator for electric motors; Nathaniel S. Keith, San Francisco, Cal.

416,191 Electro-magnetic motor; Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Co., same place.

416,192 Method of operating electro-magnetic motors; Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Co., same place.

416,193 Electro-magnetic motor; Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Co., same place.

416,194 Electric motor; Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Co., same place.

416,195 Electro-magnetic motor; Nikola Tesla, New York, N. Y., assignor to the Tesla Electric Co., same place.

416,234 416,235 Distributing box for electrical conduits; Edward S. Perot, New York, N. Y.

416,240 Electric machine; Albert Schmid, Allegheny, assignor to the Westinghouse Electric Co., Pittsburgh, Pa.

416,254 Machine for covering wire; Chas. A. Cooley, Montreal, Quebec, Canada.

416,275 Test-circuit for multiple switchboards; Chas. E. Scribner, Chicago, Ill., assignor to the Western Electric Co., same place.

416,289 Appliance for insulating electric wires; Augustus E. Ellinwood, Akron, Ohio.

416,299 Secondary battery; James K. Pumpelly, Chicago, Ill., assignor to Frank D. Thomason, same place.

416,339 Compensating electric meter; Hermann Lemp, Lynn, Mass., assignor to the Thomson-Houston Electric Co., of Connecticut.

416,350 Electric meter; Elihu Thomson, Lynn, Mass.

416,360 Electric heating apparatus; Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place.

416,366 Hinged pan for protecting electric motors for cars; Tom L. Johnson, Cleveland, Ohio.

416,381 Electric alarm; Robert D. O. Smith, Mishawaka, Ind.

416,443 Magneto-electric machine; William H. Cooley, Brockport, assignor of fifty-one one-hundredths to J. P. Dudley, Jewett M. Richmond and Wm. H. H. Newman, all of Buffalo, N. Y.

416,447 Suspending device for electric lamps; Eugene C. Dawson, Greeley, Colo.

416,476 Telephone; Edward H. Lyon, Needham, Mass.

416,503 Thermostat; Arthur G. Layent, Laconia, N. H., assignor of one-half to the Laconia Car Co., same place.

416,572 Electrical signal apparatus; Gustav W. M. Conz, Ulm, Wurtemberg, Germany.

416,573 Secondary battery; D'Estaing S. Coomb, and James K. Pumpelly, Chicago Ill., said Pumpelly assignor to said Coomb.

416,604 Electric meter; Wads. L. Hansen, Bridgeport, Ct., assignor of one-half to Frank Armstrong, same place.

416,605 Secondary battery; Thomas J. Halsam, Jr., Dublin, Ireland.

416,611 416,612 System of arc and incandescent electric lighting; William Hochhausen, New York, N. Y., assignor to the Excelsior Electric Co., same place.

416,632 Incandescent electric lamp; Luther H. Leber, York, assignor of one-half to Geo. B. Anderson, Pittsburgh, Pa.

416,654 416,655 Galvanometer; Wm. Thomson, Glasgow, County of Lanark, Scotland.

416,682 Shade or reflector for electric lights; Wm. B. Lawrence, New York, N. Y., assignor of one-half to Alfred A. McCreary, same place.

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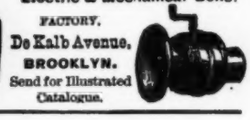

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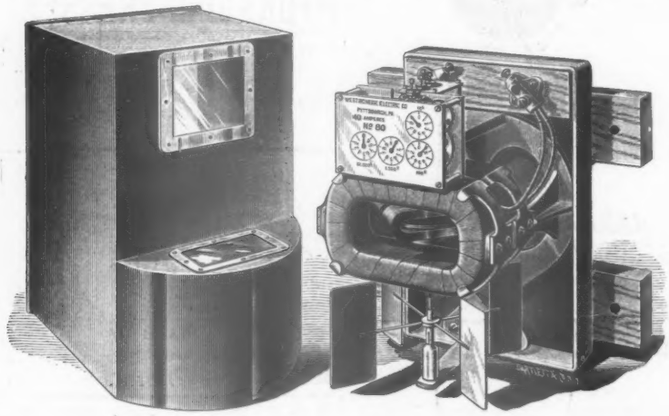

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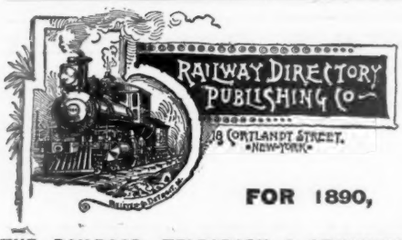

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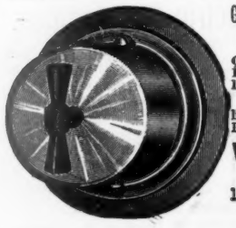

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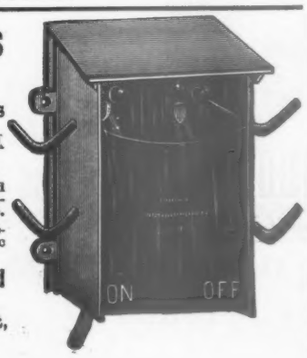

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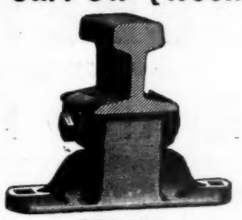

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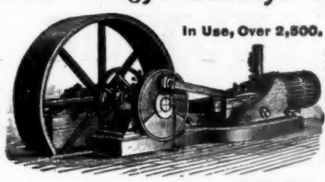

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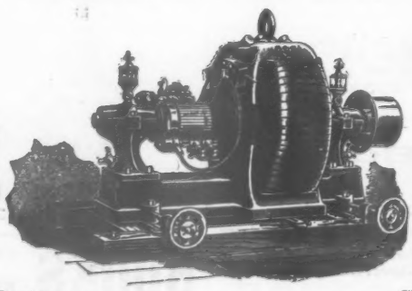

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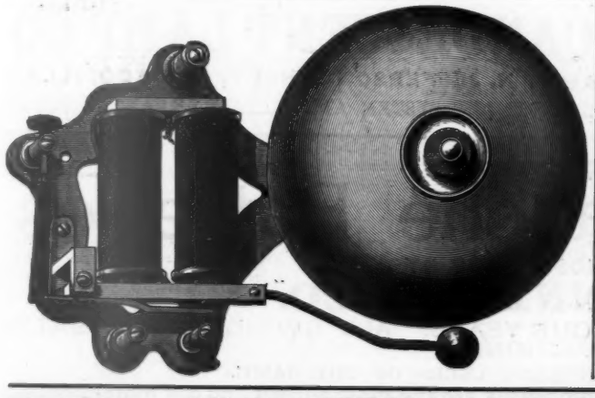

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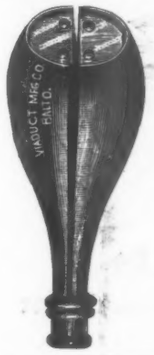

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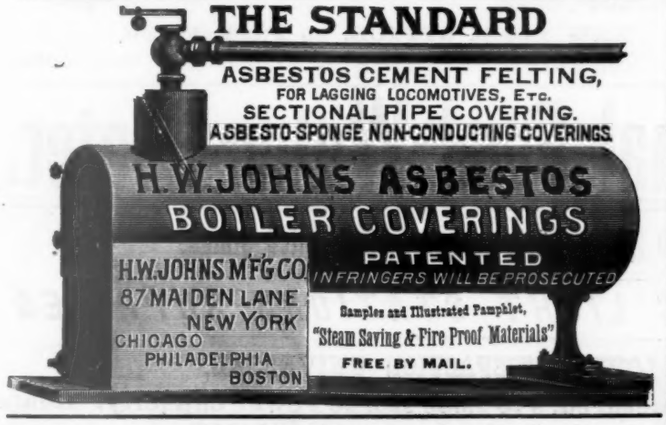

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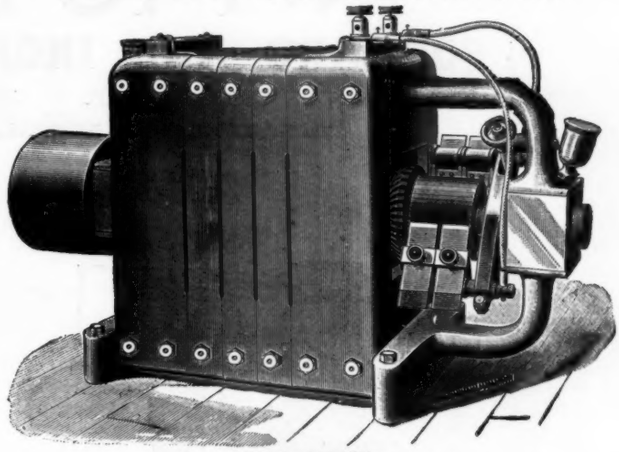

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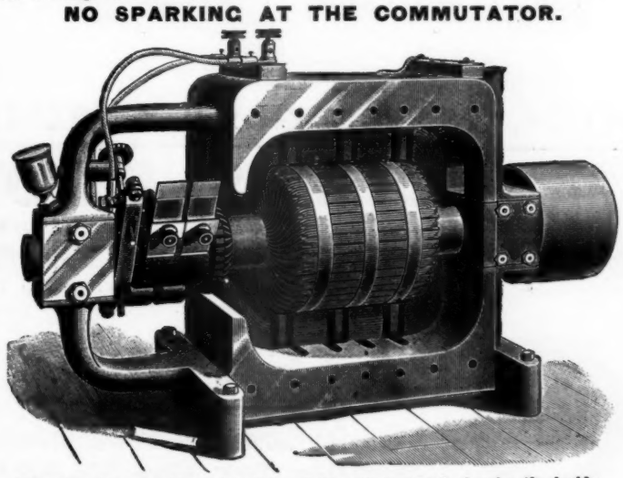

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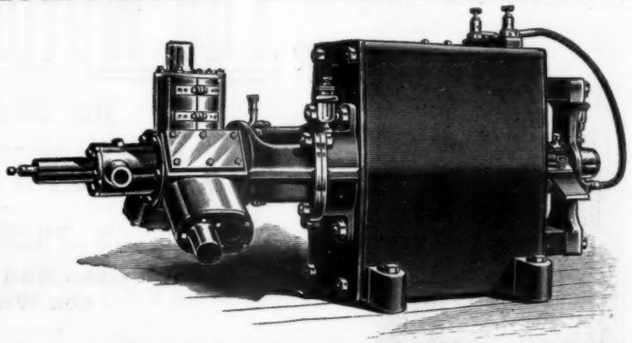

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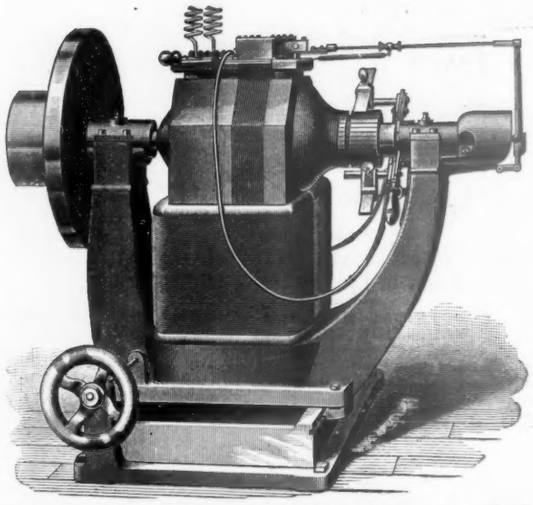

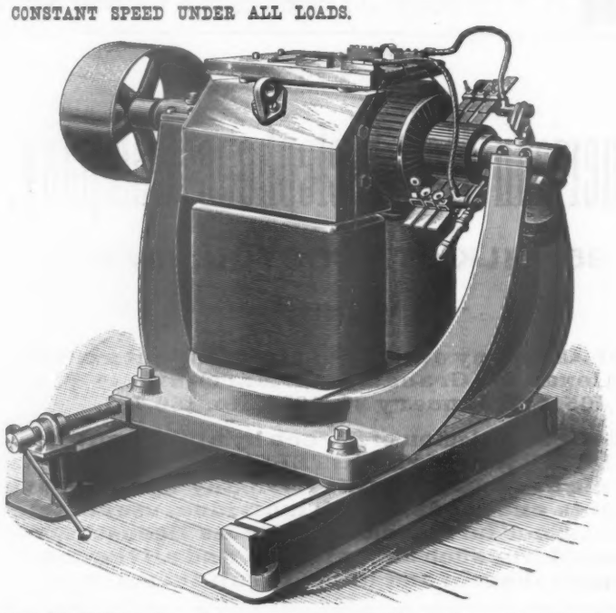

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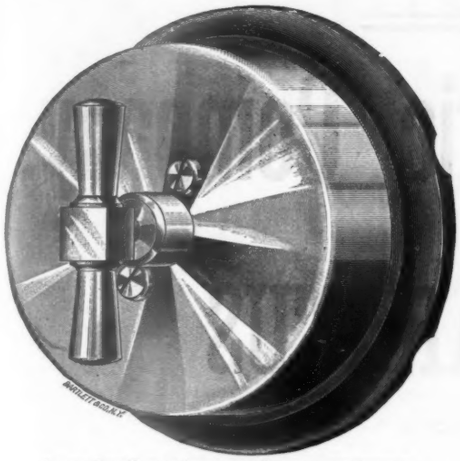

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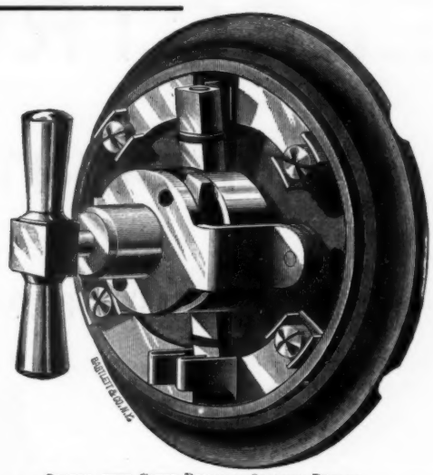

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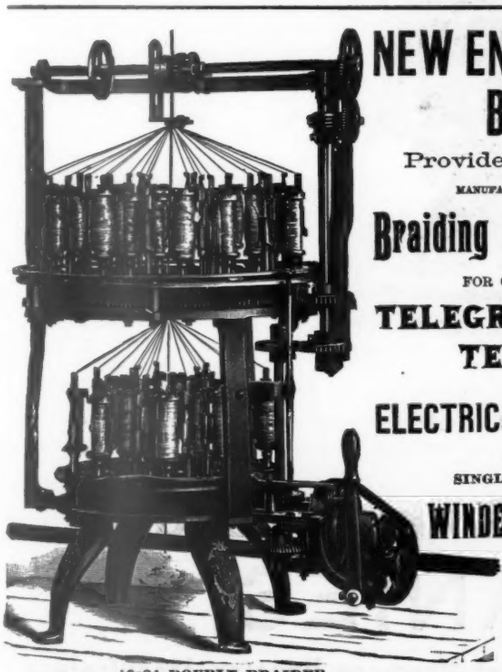

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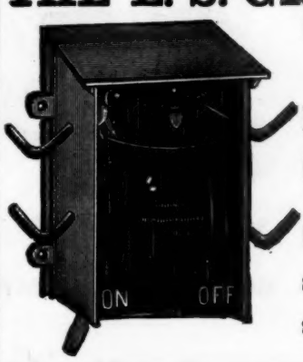

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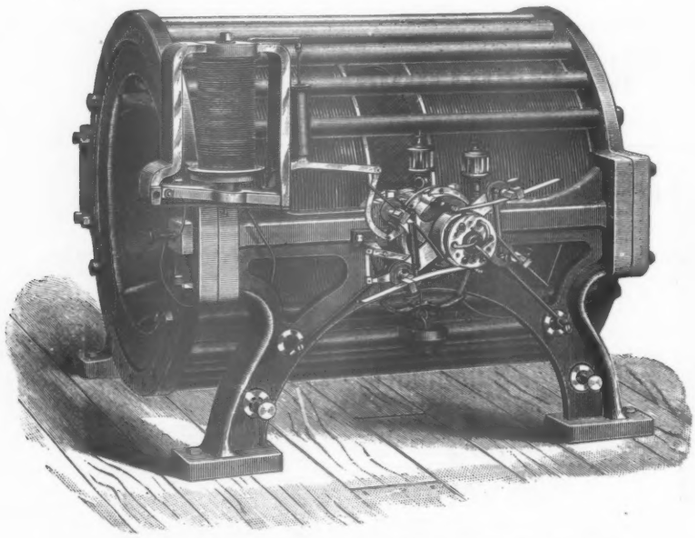

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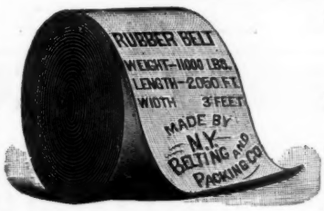

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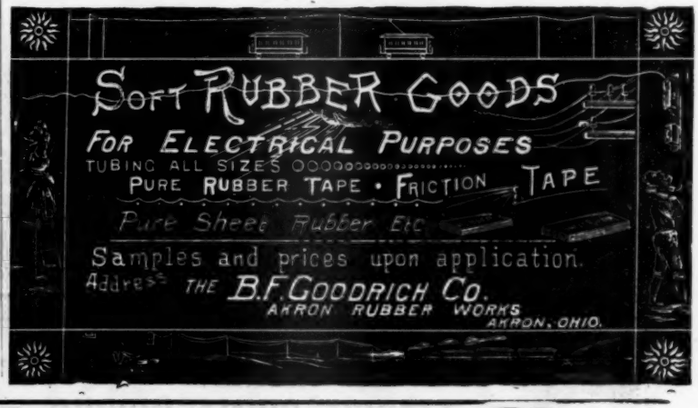

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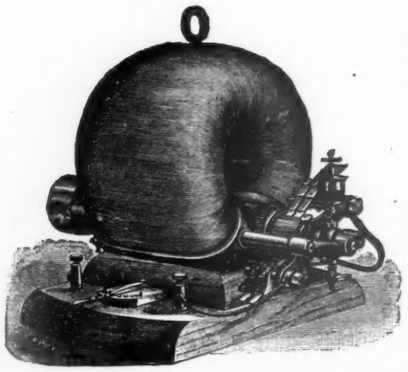

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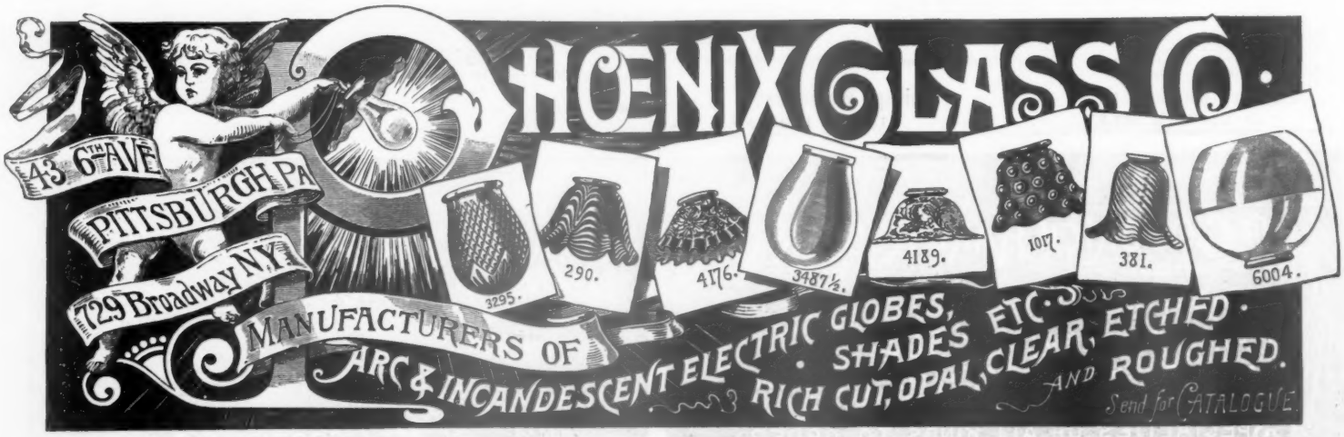

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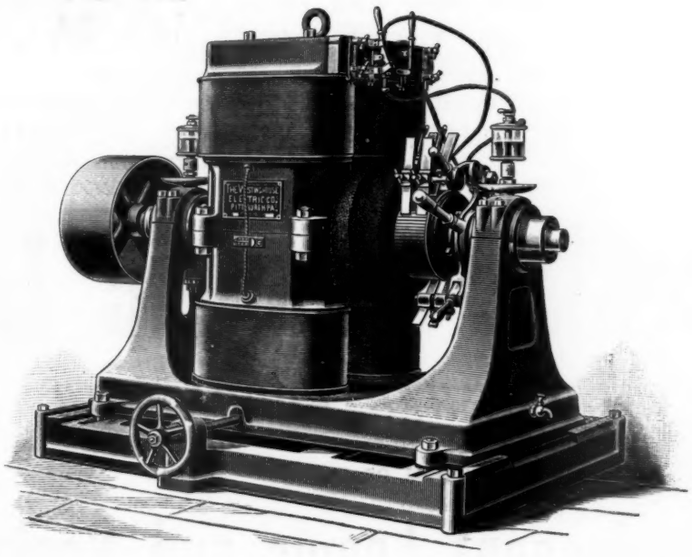

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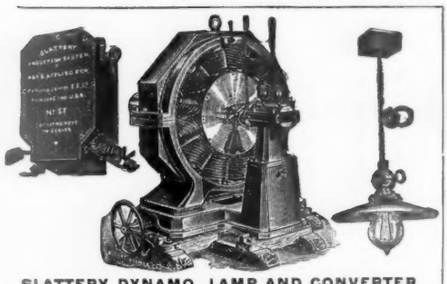

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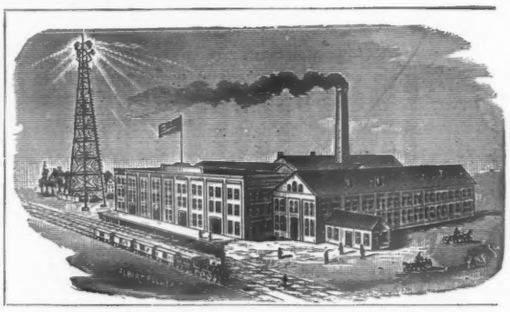

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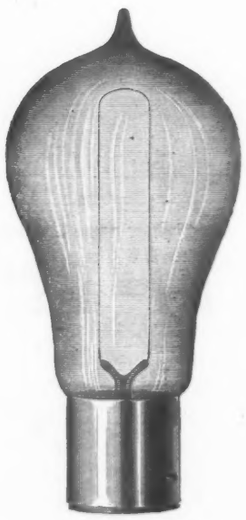

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